AD 458260

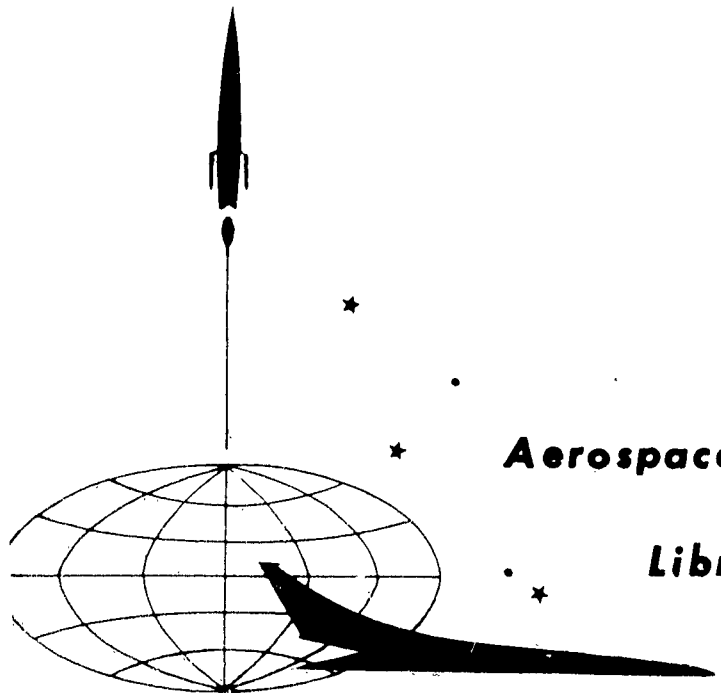
ATD Report P-65-6

1 MARCH 1965

Surveys of Soviet-Bloc Scientific and Technical Literature

SURFACE CHARACTERISTICS OF THE MOON, MARS, AND VENUS

Annotated Bibliography



Aerospace Technology Division

Library of Congress

ATD Report P-65-6

1 March 1965

Surveys of Soviet-Bloc Scientific and Technical Literature

SURFACE CHARACTERISTICS OF THE MOON, MARS, AND VENUS

Annotated Bibliography

Aerospace Technology Division
Library of Congress

FOREWORD

This annotated bibliography of Soviet planetary studies from 1960 to mid-1963 has been prepared in response to ATD Work Assignment No. 79, Task 2. Soviet-bloc research of the surface characteristics of Mars, Venus, and the Moon with reference to light polarization and albedo measurement techniques as well as radioastronomical studies have been included. The bibliographic entries are listed alphabetically by author in four sections: I) The Moon; II) Venus; III) Mars; and IV) Tektites. In cases where the primary source is not available in the collections of the Library of Congress, the secondary source is indicated. Library of Congress call numbers are provided for all sources which are in the collection. Call numbers of sources which appear several times throughout the report are listed at the beginning of the report. For an earlier comprehensive treatment of Soviet planetary studies, the reader is referred to Aid Reports 62-87, 61-30, 61-138, and 62-4 which discuss the physical properties of planetary atmospheres, the atmosphere Venus, the atmosphere and surface of Mars, and the atmosphere and surface of the Moon, respectively. More recent findings, from about mid-1963 through mid-1964, are included in Appendixes A—C in the form of SCAN items These entries are listed chronologically by subject. Full translations of some of the source materials used in this report may be available from other agencies or commercially. Interested readers may obtain translation data for individual sources by indicating source numbers from the bibliography list on the form attached to the end of this report and returning it to the Aerospace Technology Division.

TABLE OF CONTENTS

SURFACE CHARACTERISTICS OF THE MOON, MARS, AND VENUS

I. The Moon

1. Akimov, L. A. Light reflection from the lunar surface. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 26, 1963, 43-46.
TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 7, 1964, 7.51.470.

Photoelectric observations were made of the Moon with the 270-mm reflector of the Kharkov Astronomical Observatory. Photometric cross sections were obtained of the disk at stopped clock mechanism. The results of observations are presented graphically in the form of brightness distribution along the lunar disk at different phases. The law of light reflection from the lunar surface can be presented in the form

$$B = A_0 f(\alpha)\varphi(\lambda, \alpha),$$

where A_0 is the brightness of the detail at full moon, α is the phase angle, $f(\alpha)$ is the invariant phase function, λ is the selenocentric longitude, and $\varphi(\lambda, \alpha)$ is the function expressing the brightness distribution along the disk at a given phase. The last function may be represented by the following expressions: a) $\varphi(\lambda, \alpha) = 1$ for sectors from the limb to the subsolar meridian at $\alpha \leqslant 90°$; b) $\varphi(\lambda, \alpha) = \cos(\alpha - \lambda)$ for sectors between the subsolar and central meridians at $\alpha \leqslant 90°$ and along the entire disk at $\alpha \geqslant 90$; c) $\varphi(\lambda, \alpha) = \cos(\alpha - \lambda)/\cos\lambda$ for sectors between the central meridian and the terminator. By integrating the first expression, a phase dependence was obtained that showed good agreement with the corresponding phase dependence of the integral brightness of the Moon.

2. Barabashov, N. P. Comparison of lunar objects with terrestrial rocks. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 19, 1958, 3-26.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 7, 1962, 7 A520.

To compare objects of the lunar surface with terrestrial rocks with respect to albedo and color, both old (Potsdam, 1908-1910)

and new (Kharkov) data were utilized. One hundred thirty-two photos of the Moon taken through five light filters were used. The brightness of the objects measured were expressed in stellar magnitudes. The value of the stellar magnitude of the brightness of each object at λ = 500 mμ was taken as the zero point, so that the data obtained reflects the relative variation of the reflecting power. It is concluded that lunar objects most resemble volcanic rock (porous tuffs, vesicular lava, and ashes).

3. Barabashov, N. P. Nature of the Moon. IN: Trudy, 3-go s"yezda Vsesoyuznogo astronomo-geodezicheskogo obshchestva, 1960 (Transactions of the 3rd Congress of the All-Union Astronomical and Geodetic Society, 1960). Moskva, 1962. 59-66.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 10, 1962, 10 A434.

This survey article presents hypotheses on the structure of the lunar surface, results of current investigations of the physical conditions on the Moon, the microrelief of the surface, the homogeneity of the surface with respect to the structure and color, radiometric and radioastronomical data, photos of the far side of the Moon, etc. Future astronautical investigations of the Moon are considered.

4. Barabashov, N. P. On the change of brightness of lunar details as a function of azimuth and on cross sections of lunar indicatrices. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 3, 1961, 31-40.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 6, 1962, 6 A480.

The dependence of the brightness of lunar objects on the difference of azimuths of the incident and reflected rays is investigated. The effect of the difference of azimuth is shown. Sections of indicatrices for i = 30° and 60° with planes perpendicular to the plane of incidence and passing through the incident ray are given. It is concluded that these investigations confirm the postulated homogeneity of the microrelief of the lunar surface and that the change of brightness of lunar seas and continents as a function of the change of azimuth difference corresponds reasonably well with data for fragmented tuff whose grain size is 2—6 mm.

5. Barabashov, N. P. Microrelief of the lunar surface. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 23, 1961, 3-14.

The brightness distribution over the lunar disk is represented by a model of the surface structure with two types of irregularities: one several millimeters in size and the other grain-like in shape. Based on comparisons of the indicatrices of reflected light, it is concluded that a porous tuff is the most likely lunar cover.

6. Barabashov, N. P., and L. A. Akimov. On the question of the surface of the Moon. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 26, 1963, 14-19. TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 7, 1964, 7.51.469.

The dependence of the brightness on the difference in azimuth of the incident and reflected rays at different, but mutually equal angles of incidence and reflectivity, has been investigated for several samples by means of a specially designed automatic electric indicator. It has been established that on the basis of the photometric data the lunar surface corresponds best to an extraordinarily porous spongy material with a very fine and opaque wall as well as to material consisting of pointed grains of crushed tuff about 5 mm in size.

7. Barabashov, N. P., and V. I. Garazha. Microstructure of the lunar surface. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 24, 1961, 3-13.

It is shown that all the characteristics of light reflection from the lunar surface are satisfied by a model of volcanic tuff consisting of square cells. The side of each cell is 1 m, the thickness of the walls is 0.20 m, and the depth ranges from 1.5 m to 2 m. Six-sided cell characteristics were also lunar light reflection characteristics. It is thought that the lunar surface is covered by randomly distributed rocks. Tuff fragments with grains ranging from one to several millimeters are found to satisfy light reflection characteristics and is similar to the lunar surface with respect to heat conductivity, density, electrical conductivity, and other characteristics.

8. Barabashov, N. P., and V. I. Yezerskiy. Photometric investigations of the microrelief of the lunar surface. IN: Kharkov State University. Uchenyye zapiski. Astronomicheskaya observatoriya. Trudy, no. 14, 1962, 5-78.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 12, 1962, 12 A477.

This article is a historical survey of the basic works on photometric investigations of the microrelief of the lunar surface. The article presents basic data on the microrelief obtained by study of the polarization and thermal properties of the lunar surface.

9. Barabashov, N. P., and V. I. Yezerskiy. Spectrophotometric observations of lunar craters. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 3, 1961, 50-55.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 6, 1962, 6 A482.

The results of spectrophotometric observations of Alphonsus and other craters at the Kharkov Astronomical Observatory in 1958-1959 are given. No anomalies were detected in the reflecting power of individual sectors of lunar craters, including the central peak of Alphonsus.

10. Barabashov, N. P., V. A. Yezerskaya, and V. I. Yezerskiy. On the question of the photometric method of investigating the relief of the lunar surface. IN: Kharkov. Universitet. Uchennyye zapiski. Astronomicheskaya observatoriya. Trudy, no. 14, 1962, 107-110.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 5, 1963, 5.51.495.

The photographic method of determining the steepness of slopes and heights in lunar seas, first proposed by I. Diggelen [reference given], is developed further. This method provides direct data on slopes when the photometric sections are made sufficiently close to the equator of intensity and in directions parallel to it. For such measurements large-scale photos of the Moon with a resolution of less than 1" are most suitable. Measurements of a photograph of the Moon obtained at a phase angle of 77° 5' and image diameter of 59 mm. Photometric measurements along Arzachel and Archimedes, obtained on the self-recording MF-4

micrometer, are shown in sketches. In Arzachel Crate. the inclinations for the eastern and western slopes are 13° 5' and 6° 8', while for Archimedes they are 2° 1' and 4° 2'. Comparison of photometric measurements with results obtained by the shadow method will make it possible in the future to study the microrelief of different parts of the crater.

11. Benes, Konrad. Attempt to explain the geologic structure of the southwestern part of Mare Imbrium. Rise hvezd, v. 41, no. 11, 1960, 213-215.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 3, 1962, 3 A504.

Geomorphological analysis of the southwestern part of Mare Imbrium suggests the following sequence of development of the various formations: Terra Archimedes (Apennines), including the Archimedes rampart; the mountainous massive crossing the Palus Petrudinis, including Spitzbergen; the main part of Mare Imbrium including Palus Petrudinis; the Aristillus and Autolicus systems; minor craters and craterlets. Hypothetical geologic sections of some regions of the Mare Imbrium are given.

12. Benes, Konrad. Lunar continents and their morphological types. Rise hvezd, v. 41, no. 8, 1960, 153-156.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 3, 3 A503.

The following classification of lunar continents is proposed: 1) crater type (south and central regions of the visible side), 2) mountain range type, and 3) Jurassic type. The characteristics of each type and the comparative age of the different formations were examined. An endogenic origin was assumed.

13. Benes, Konrad. Physiography of the lunar surface. IN: Ceskoslavenske spolecnosti zemepisne. Sbornik, v. 67, no. 3, 1962, 193-199.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 2, 1963, 2.51.514.

Two main types of lunar crust, viz., one that developed on the uplands and another that developed in the lowlands, are described.

A protosialic crust forms the outer selenosphere. The thickness of its cover varies — which is an important factor in studying the polar regions. In some places where the cover is broken it is possible to see magmatic rock refusion and other phenomena. A dust cover derived from tuff apparently exists on the Moon, but it is not a continuous cover and is discussed. The following stages occurred in the development of Mare Imbrium: 1) the formation of broad cupola structures; 2) the outburst of convex sectors and the separation of gas from the subcrustal basin; 3) the outburst of arched sectors and the effusion of magmatic material in depressions; and 4) solidification and stabilization. The author calls for a geographic regionalization of the visible side of the Moon based on internationally accepted lunar criteria, after which, work on lunar geography and the establishment of physiographic regions would begin. To date no selenographic description of the lunar ridges in the seas is available. A listing of Czech terms for lunar formations is proposed.

14. Benes, K. Outline of the similarities and differences in the geological development of the Earth-Moon system. IN: Akademiya nauk SSSR. Izvestiya. Seriya geologicheskaya, no. 11, 1962, 50-57.

In a general review of the Earth-Moon system, it is stated that comparisons of their geological development should take into account the fact that the evolution of the Earth's crust and its surface proceeded under conditions of an antagonistic interaction of endogenous and exogenous geological factors, while the development of the Moon was determined mainly by endogenous forces. Basically, however, the development of the hard crust of both bodies was effected by magmatic, metamorphic, and volcanic processes. The conditions for the development of lithospheres were not the same, however, and, consequently, the two surfaces differ greatly. The lithosphere of the Moon has apparently been preserved more or less in the "inchoate planetary state," making it possible to look into the development of the solar system at some depth. On the other hand, the Earth's crust has been, since its formation, in a state of continuous motion, transformation, regeneration, and "heterogenization," particularly in continental zones. The fact that the Moon does not have and apparently never had a dense atmosphere rules out the possibility of interaction of the lithosphere, atmosphere, hydrosphere, and biosphere. From the

structural standpoint, the surface of the Moon is consequently not at all similar to that of the Earth. Differences in the energy processes and in particular features of the space surrounding the Earth and Moon are responsible for the radical differences in the development of these two bodies. While the Earth continued to develop, the Moon stopped rather quickly in its development.

15. Benevolenskiy, A. M. Role of cumulative processes in the formation of lunar walled formations. IN: Vsesoyuznoye astronomo-geodezicheskoye obshchestvo. Byulleten', no. 30, 1962, 20-27.

    Experiments are conducted to show that lunar walled formations were formed by meteorites impacting at the time the crust of the Moon was hardening.

16. Beskrovnyy, N. S. On the causes of lunar rock luminescence. Priroda, no. 12, 1962, 100. Q4.P8

    Following Kuprevich's discovery that lunar rocks luminescence under the influence of ultraviolet solar radiation, studies have been made to determine the cause of luminescence. It is postulated that lunar rocks in zones of deep faults, in particular near Tycho Crater, contain either oil bitumens or rare-earth minerals or perhaps both together.

17. Bondar', L. N., M. R. Zelinskaya, V. A. Porfir'yev, and K. M. Strezhneva. Precision measurement of lunar radiation at the 3.2-cm wavelength. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 5, no. 4, 1962, 802-804. QC661.R8

    The method of continuous calibration by means of an absorbing disk used as a standard and placed in the far zone has been used in measuring lunar radiation at the 3.2-cm wavelength. Measurements were carried out with both small (1.5 m) and large (4 m) telescopes at the same wavelength in an attempt to determine the brightness temperature at the center of the Moon. Absolute lunar temperature was determined by measuring the difference in signals obtained with 1) an antenna directed toward the center of a raised and lowered disk and 2) an antenna directed 2—3° away from the Moon. The radiotelescopes used had a fluctuation threshold of 1° at a time constant of 1 sec. The width of radiation patterns at half-powder points was 87' and 40' for the small

and large antennas, respectively; the efficiency of the antenna systems was 70%. The standard disk was 4.2 m in diameter and consisted of six sections coated with absorbing material. The disk was placed against the background of the sky at a distance of 471.8 (± 1) m with an elevation of 19°. Correction for diffraction was less than 0.5%. The lunar temperature determined experimentally as a function of the phase of the Moon was found with the use of the small antenna to be 213° + 14° cos (Ωt - 26°) and with the large antenna, 216° + 16° cos (Ωt - 15°). The effect of "warming" of the disk was detected. It is suggested that the effect is due to reflection of earth radiation by the disk. The authors are connected with the Gorkiy Scientific Research Institute of Radiophysics.

18. Breydo, I. I., A. A. Markelova, and D. Ye. Shchegolev. Appearance of reliable objects on the far side of the Moon on the basis of the first photographs. Iskusstvennyye sputniki zemli, no. 9, 1961, 30-40. TL796.I8

19. Bülow, Kurd von. Corrections for the picture of the far side of the Moon. Forschungen und Fortschritte, v. 35, no. 8, 1961, 225-228.
TAKEN FROM: Referativnyy zhurnal, Astronomiya i geodeziya, no. 3, 1962, 3 A515.

A detailed description is given of the Atlas of the Far Side of the Moon. The continuation of the belt of seas to the far side is confirmed. The conclusion as to the presence on the far side of meridionally oriented tectonics can only be accepted with reservations inasmuch as the nature of the Soviet Range is not quite clear. The basic conclusion is upheld that the differences between the near and far sides of the Moon are merely quantitative and not qualitative.

20. Bülov, Kurd von. Height relationships on the visible side of the Moon. Kosmos, no. 2, 1963, 74-79.

Developments in the compilation of lunar topographic maps are discussed in a popular style. The charts of Franz (1961) are compared.

21. Bülov, Kurd von. Structure and development of the lunar crust. Raketentechnik und Raumfahrtforschung, v. 4, no. 3, 1960, 93-97.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 3, 1962, 3 A501.

The morphological elements of the lunar crust that give evidence of their development are analyzed. There are three major tectonic systems manifested in the distribution of craters and configurations of the seas. The seas were formed as a result of the subsidence of the subcrustal mass and subsequent contraction of the crust. At the same time a rapid collapse of the seas occurred, thereby making it possible to reproduce the developmental processes of lunar tectonics. The general structure of the crust indicates the presence of a meridional fracture on the surface of the Moon and a diagonal grillwork in the continents. Photos of the far side of the Moon are examined from the point of view of supporting views on the development of the visible side. An analog is made between the tectonics of the Earth, Moon, and Mars which may help in uncovering the general laws of planetary development.

22. Chekirda, A. T. Sixth Plenum of the Commission of Planetary Physics of the Astronomical Council of the Academy of Sciences USSR. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 3, 1961, 96-99.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 9, 1962, 9 A33.

The plenum of the Commission was held in Kharkov on 24-27 October 1960. The reports dealt with the results of processing the first photos of the far side of the Moon (Barabashov, Lipskiy, Shchegolev, et al.), radio investigations of the Moon (Kaydanovskiy, Salomonovich), photometric, polarization, and other methods (Sharonov, Teyfel', Dzhapiashvili, et al.), as well as theoretical studies (Levin, Ruskol). Several reports concerned Mars, Venus, and Saturn.

23. Chistyakov, Yu. N. Attempt at determining the temperature of separate sectors of the lunar surface. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 2, 1960, 46-54.

Measurements were made in March 1959 of the temperature of separate sectors (1.5' x 1.5') of the lunar surface, using a

modified version of the method proposed by Menzel. A vacuum thermoelement with a sensitivity of 10 v/wt, set in the Newtonian focus of the 13" reflector of the Abastumani Observatory, was employed for measurements. Computational results show that the temperature of the subsolar point for a phase angle α of +17.2 is 375°, which coincides with the value arrived at theoretically by Pettit for a full Moon. The temperature of the seas is about 10° higher than that of the adjacent continents. The ratio of the visual and radiometric albedos of separate points is the same as the ratio of mean albedos over the disk.

24. **Derkach**, K. N. Photographic and photoelectric polarimetry of the Moon through light filters. IN: Kharkov State University. Uchenyye zapiski. Astronomicheskaya observatoriya. Trudy, no. 14, 1962, 79-85.
TAKEN FROM: Referativnyy zhurnal, Astronomiya i geodeziya, no. 12, 1962, 12 A478.

Polarimetric investigations of sectors of the lunar surface in red, yellow, green, blue, and integral light are reported. The polarimetry was performed with the 8" refractor of the Kharkov Observatory, using photographic and electrophotometric methods. The maximal level of polarization for all measured sectors was observed in blue light. The electropolarimetric investigations indicate that the minimal level of polarization of most details is in the yellow light, while a minority have minimal level in the green.

25. **Dolginov**, Sh. Sh., Ye. G. Yeroshenko, L. N. Zhuzgov, and N. V. Pushkov. Geomagnetizm i aeronomiya, v. 1, no. 1, 1961, 21-29.

Rocket data indicate that the Moon has no significant magnetic field. It is estimated that the dipole magnetic moment of the Moon must be less than 1/10,000 of the magnetic moment of the Earth.

26. **Dzhapiashvili**, V. P., and L. V. Ksanfomaliti. Electronic polarimetric images of the Moon. COSPAR. Fourth International Space Science Symposium, Warsaw, Poland. 3-12 June 1963.

Since 1962 a special electron polarivisor has been in use at the Abastumani Astrophysical Observatory to make polarimetric observations of the Moon and planets. Observations of the Moon

made during different phases have identified surface objects designated as "polaricirques" and "polaricraters." An improved model of the polarivisor was put into operation in the beginning of 1963. A third model, which will better permit resolution of separate details on the polarimetric images, is now being designed.

27. Eygenson, M. S. On the question of the pregeologic and geologic phases of lunar history. IN: Lvov. Universitet. L'vovskoye geologicneskoye obshchestvo. Geologicheskiy sbornik, no. 7-8, 1961, 229-238.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 5, 1962, 5 A476.

In the first stage of lunar history as a planet, the Moon had an unusually rich subcrustal source of lava. Computations show that the lunar interior today is solid. This agrees with the current general tectonic passivity of the Moon. However, it is possible that local lava sources have been preserved in places of random accumulations of radiogenic sources and in the crust of the Moon.

28. Fischer, K. Spectral image converter and its use in selenography. Die Sterne, v. 38, no. 9-10, 1962, 181-184.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 6, 1963, 6.51.484.

The circuit of an image converter used for visual observations of objects in the infrared is described. Observations were made with the 3-m dual refractor of the Prague-Podolia Observatory. A Schott RG 10 (2 mm) filter cutting off the region shorter than λ 7500 was used. Maximum of sensitivity of the AEG and Tesla 22QA 41 with an AG-O metal cathode was in the λλ 7000-9000 region. The installation was used for observing the Moon in the infrared. The following characteristics were noted: 1) the seas and some craters (Plato, Grimaldi, etc.) have a smaller albedo in the IR than in the visible light; 2) the mountainous regions usually have a greater albedo in the IR than in the visible light; 3) in some cases the IR albedo depends on the angle of solar ray incidence at the slopes (Tycho Crater, Theofilus, and Cyrillus). It is suggested that a lunar map be compiled for the infrared. Observations of the lunar eclipse of 28 June 1961 led to the conclusion that in comparison with visual observations, the

phenumbra was sharper in the IR while the phase of the shadow eclipse was greater. This caused a shift to the moments of the phase values by 3—5 min. Observations of the nonilluminated part of the Moon in the IR did not reveal any IR emission sources indicative of volcanic activity.

29. Grushinskiy, N. P., and M. U. Sagitov. Some considerations on the gravity field of the Moon. Astronomicheskiy zhurnal, v. 39, no. 1, 1962, 151-157.

    The gravity field of the Moon is studied on the basis of recent data on the mass and form of the Moon.

30. Hedervari, Peter. On the energy required to form craters and ringed formations on the Moon. Magyar fiz. folyoirat, v. 9, no. 4, 1961, 251-264.
    TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 3, 1962, 3 A498.

    All signs indicate that the majority of lunar craters ($D \leq 20$ km) and ringed mountains ($D > 20$ km) were formed by internal lunar forces. It is shown that the source of energy required to form these formations as well as to form mountain chains could result from lunar expansion. In this case the amount of energy generated would exceed that required for mountain-building. On the basis of using formulas for determining heat energy expended in forming terrestrial volcanic islands and in the formation of craters and ringed mountains, it can be established that, depending on the diameters of the latter, 10^{25}—10^{30} ergs of energy were required. It is shown that the energy required to form the largest ringed mountains is of the same order of energy as that required to form the Hawaiian volcano Mauna Loa. This energy is 5.6×10^5 times greater than the energy of the strongest earthquake tremor in Chile in 1960.

31. Iozlova, K. I., and Yu. V. Glagolevskiy. Color excesses and indicies of several lunar craters as determined from photoelectric measurements. IN: Akademiya nauk Kazakhskoy SSR. Sektor astrobotoniki. Trudy, v. 8, 1960, 125-129. QK1.A35866

    Photoelectric observations of 15 lunar craters were made in Alma-Ata on the AFM-3 electrophotometer attached to the

AZT-7 telescope in yellow and blue light with λ_{eff} 420 and 535 mμ. CE values of these craters were obtained with respect to Manilius Crater. The CE value of the latter with respect to Capella was $+0^m.026 \pm 0^m.008$. The CI values of the craters were obtained on the basis of the known CI value of Capella $CI_5 = 0.82$. It is concluded that no great difference exists in the color of the craters studied, although some slight ones are noted. The CI were from $+0^m.717$ to $+0^m.890$; the mean CI value is $+0^m.830$.

32. Kalinenkov, N. D., Yu. V. Vladimirtsev, V. M. Grigor'yev, and V. I. Skomorovskiy. Photoelectric unit for investigating the Moon and the planets. IN: Akademiya nauk SSSR. Astronomicheskaya observatoriya im. V. P. Engel'gardt. Byulleten', no. 36, 1961, 61-66.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 12, 1962, 12 A165

The unit consists of an electrophotometer, photoelectric spectrophotometer, and spectropolarimeter. Rapid interchangeability of parts is possible in switching from one kine of observation to another. Usually a slit spectrograph is screwed to the ocular end of the telescope. The photographic headpiece, consisting of a photomultiplier and the projecting and guiding systems, can be attached in front of the spectrograph slit. The d-c amplifier is, arranged according to the Moroz' Plan with insignificant changes. The ЭПП recording device is used. Under favorable weather conditions it is possible to observe the Moon, planets, and stars to the $7-8^m$. The spectrograph has a glass optical system; it is a single prism device with a dispersion of 80 A/mm at Hγ. There are attachments for inserting comparison spectra, calibration, and standardization scales. The second slit of the spectrograph can be uniformly shifted along the dispersion. To lessen the influence of changes in atmospheric transparency, scintillation, and other interference, a subtracting system with light beam division and two photomultipliers is used. To decrease the signal-to-noise ratio a special resistor arrangement is used in the photomultiplier power dividers. Signals from there to the subtracting device whose output is recorded on a d-c oscillograph with flat screen. The screen is photographed. A polaroid with a rotation system can be placed in front of the spectrograph slit instead of the electrophotometer headpiece. The monochromatic beam passing through the second slit of the spectrograph is modulated in the case of light polarization. The

signal from the photomultiplier of the spectrophotometer is sent to the vertical plates of the oscillograph; the horizontal sweep is synchronized with the rotation of the polaroid. There is a device to determine the position angle on the oscillogram. The instrument polarization is accounted for by the subtracting device. The polarimeter measures the monochromatic (4—8 A) polarization of the order of 1%; the accuracy of determining the degree of polarization is not less than 0.1%, and of the position angle from 1 to 5°. Optical and electric systems are shown in shematics.

33. Kamenskaya, S. A., B. I. Semenov, V. S. Troitskiy, and V. M. Plechkov. Lunar radio emission at 1.6-cm wavelength. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 5, no. 5, 1962, 882-884.

From June through September 1961 the Scientific Research Institute of Radiophysics, Gorkiy University, conducted experiments to establish the intensity of 1.6-cm radiation from the Moon during several lunar cycles. A horizontally polarized paraboloid with a 44' beam width at half-power points and a gain of 3.87×10^4 at $\lambda = 1.6$ cm was used as the receiving antenna. Lunar radiation was referenced to a black-body standard consisting of a coated aluminum disk placed within the Fraunhofer region of the antenna. On the basis of recorded data on radiation and disk temperatures a formula was derived, with correction coefficients introduced for atmospheric effects, which yielded lunar radio temperatures of $T = 208° K + 37° K \cos(\zeta + -30° K)$. A plot of calculated temperatures versus lunar phase shows a nearly sinusoidal variation. The rated rms error in calculating constant and time-varying temperature components did not exceed $\pm$ 3%.

34. Kaydanovskiy, N. L., and A. Ye. Salomonovich. On determining the surface characteristics of the Moon from observations made with high-resolution radiotelescopes. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 4, no. 1, 1961, 40-43.
TAKEN FROM: Referativnyy zhurnal, Astronomiya i geodeziya, no. 1, 1962, 1 A381.

A method of processing observations of lunar radio emission made on high-resolution radiotelescopes is proposed. Unlike the usual methods used in the case of radiotelescopes of moderate resolving power, it is possible to construct curves showing the change of the relative radiative power and the

latitudinal distribution of surface temperature directly from the observational data. The characteristics of the lunar surface can then be determined without additional assumptions as to the form of the curves.

35. Khabakov, A. V. Nature of some characteristics of the details on the map of the far side of the Moon. Iskusstvennyye sputniki zemli, no. 9, 1961, 52-55.

36. Khodak, Yu. A. The most important structural elements of the Moon. Kosmicheskiye issledovaniya, v. 1, no. 3, 1963, 465-471.

The character and location of lunar topographic features are analyzed to trace the principal structural elements of the Moon. Recent photographs, maps, and other data on lunar relief are employed. The paper focuses on three fundamental structural elements said by the author to have been formed about 300 million years ago: 1) a meridionally extended ancient massif embracing the western portion of the far side and the southern portion of the visible side; 2) the Great Belt of large depressions (seas) located within the massif and extending convexly in the form of a semicircle to the north pole from the South Sea to the Sea of Moisture; 3) the meridional belt of large depressions of the far side of the Moon, located on the edge of an uncharted lunar area. Within these, it is possible to trace the evolution of blocs limited by a system of global depth fractures extending in four directions for thousands of kilometers: meridional, submeridional, latitudinal, and sublatitudinal. The geophysical significance of these fractures (breaks) is discussed, and the most ancient systems are traced in detail. The author states that approximately 100--150 million years ago the Moon had to a large degree inherited its ancient structural plan; the central meridional zone of fractures of the southern hemisphere was the most mobile, while the far side was fairly stable. In succeeding periods a further differentiation of structural elements along the depth fault zones created the present enormous blocs. A demonstration of this hypothesis is given. The author cites the evidence of A. V. Peyve ("Struktura zemnoy kory i deformatsii gornykh porod," Izd-vo AN SSSR, 1960, 67) and G. N. Katterfel'd (Izv. Vses. geogr. o-va, v. 91, no. 272, 1952) on the existence of a bloc structure on the Earth and Mars as reason for investigating the possibility of a general law operative in the development of a hard core in these bodies.

37) **Kislyakov, A. S., B. Ya. Losovskiy, and A. Ye. Salomonovich. Radio emission from lunar seas and continents in the millimeter wavebands. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 6, no. 1, 1963, 192-193.**

A series of lunar radio emission observations was carried out in March—June 1961 by means of the 22-meter radio telescope at the P. N. Lebedev Physics Institute, Academy of Sciences USSR. The purpose was to distinguish lunar surface regions with different physical properties according to their brightness temperatures. Emission was recorded simultaneously on two wavelengths (λ = 8 mm and λ = 4 mm). The telescope resolution was sufficient to identify radio emission from separate regions with angular dimensions of 2—3'. As a result, graphs illustrating the brightness temperature distribution along the lunar equator, as well as along its central meridian, were obtained. While the radio brightness distribution showed no correlation with the optical map of the lunar surface, it was shown from analysis of meridian brightness temperature distribution that the radio emissions of lunar seas and continents do differ. For comparison, two regions located on the meridian with selenographic latitudes +35° and -35° were observed. The northern region covered the western part of Mare Imbrium, and the southern embraced a mountain area close by Voltaire Crater. The values of brightness temperatures (averaged for the main lobe) T_N of the northern and T_S of the southern regions are tabulated for several dates. The difference was consistantly positive by as high as +12°K, suggesting that seas are warmer than land areas. Absolute values of T_N and T_S were deduced from the assumption that the average lunar temperature at both wavelengths equals 230°K and follows the cycle variation suggested by Salomonovich and Kislyakov.

38. **Kokhan, Ye. K. Comparison of polarization data of individual sectors of the Moon with the polarization characteristics of terrestrial rocks. IN: Pulkovo. Glavnaya astronomicheskaya observatoriya. Izvestiya, v. 22, no. 4, 1961, 65-81.** QB4.P982

The results of investigating the polarization properties of separate sectors of the Moon and terrestrial rocks from material obtained by the electropolarimeters of the Pulkovo and Abastumani Observatories are discussed. The polarization properties were obtained by studying two parameters: the degrees of polarization and the position angle of the polarization plane at different phase angles. The relationship between the degree of polarization and the wavelength is determined and seen to support the Umov effect. The degree of polarization of the moon stands in the same relationship to the albedo as does the degree of polarization of terrestrial rocks. The position of the polarization plane on the Moon does not change

from sector to sector. At large phase angles the plane coincides with the equator of intensity; at phases close to full Moon it begins to rotate. A similar relationship is seen in investigations of terrestrial rocks, but here the plane of polarization begins to rotate at a different phase angle, maintaining the same character of rotation for different rocks. It may be concluded that the state of the microstructure of the lunar surface is unlike that of terrestrial rocks.

39. **Kokhan**, Ye. K. Investigations, conducted in three regions of the spectrum, of the degree of polarization of light reflected from lunar details. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 1, 1959, 41-53.

The polarization properties of lunar formations were investigated in the total luminous flux, in the blue and in the yellow spectral regions, using special filters. The "Pulkovo" and the "Abastumani" electropolarimeters were used.

40. **Koziel**, K. Mösting-A Crater as a first-order of triangulation on the Moon. COSPAR Fourth International Space Science Symposium, Warsaw, Poland, 3-12 June 1963.

Heliometric observations of Mösting-A have been made in order to determine its selenographic coordinates and height above the mean level of the lunar surface. The following final values were computed: mechanical ellipticity of the Moon, 0.633 ± 0.011; mean inclination of the Moon's axis of rotation to the perpendicular of the ecliptic, $1^\circ 32'1'' \pm 7.1''$; selenographic longitude, $-5^\circ 9'50'' \pm 4.5''$; selenographic latitude, $-3^\circ 10'47'' \pm 4.4''$; height above the mean lunar level, $+0.40'' \pm 0.19''$. Thus, the center of Mösting-A, which has a diameter of about 11 km, lies (for an observer on the Moon) $5^\circ 9'50''$ west of the main lunar meridian and $3^\circ 10'47''$ south of the Moon's equator. Its height above the mean lunar level is 740 m. This point will serve as a basis for triangulation reference in the compilation of charts of the Moon.

41. **Kozlovskaya**, S. V. On the question of the internal structure of the Moon. Voprosy kosmogonii, no. 8, 1962, 145-149. QB981.V83 TAKEN FROM: Referativnyy zhrunal, Astronomiya i geodeziya, no. 11, 1962, 11 A259.

Several models of the Moon, some consisting of silicates characteristic of the earth and meteorites and others with a lighter crust amounting to about 5, 10, 15% of the mass, are considered.

Two values of compressibility are examined. The decrease of lunar density due to the heating of the interior is estimated. The decrease of lunar density due to the heating of the interior is estimated. Values of compressibility and the coefficient of heat expansion at which a stable or unstable model is obtained are indicated. The internal structure of the Moon is approximated by a two-layer model with a mantle that is heterogeneous in composition but constant in density.

42. Kozyrev, N. A. Night emission of the lower layers of the Venusian atmosphere. IN: Pulkovo. Galvnaya astronomicheskaya observatoriya. Izvestiya, v. 22, no. 5, 1962, 132-135.
QB4. P982

Spectrophotometric investigation of the sky background around the Venusian crescent showed the existence of a self-radiation of the lower layers of the dark (unlit by the Sun) side of Venus. The belts detected in the spectrum of this emission are with great certainty identified with formaldehyde bands. The brightness of the observed emission of the lower layers of Venus is of the order of the illumination of the full Moon on the Earth.

43. Kozyrev, N. A. The existence of volcanic activity on the Moon. IN: Moscow. Akademiya nauk SSSR. Vosprosy vulkanizma, 1962, 72-73.
TAKEN FROM: Referativnyy zhurnal, Astronomiya i geodeziya, no. 12, 1962, 12 A484.

The phenomena observed on 3 November 1958 in Alphonsus Crater are described. The author believes that basic lunar reliev is formed by endogenic processes.

44. Krotikov, V. D. Comparison of terrestrial rocks and lunar surface layer. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 5, no. 6 1962, 1057-1061.

A comparison of the characteristics of the lunar surface with those of terrestrial rocks is made on the basis of the utilization of the ratio tan Δ/ρ (where tan Δ is the loss tangent and ρ the density), whose value depends mainly on chemical composition. On the basis of lunar radiation data it was found that tan Δ/ρ for lunar surface material equals 0.005 ± 0.003. The dependence of tan Δ and ε on

frequency and density has been determined for various terrestrial rocks, both in their natural and crushed state, by a method which makes it possible to measure ε at the 0.8-, 3.2-, and 10-cm wavelengths with an accuracy of $\pm 3-7\%$ and tan λ to within $\pm 10-20\%$, depending on the wavelength and magnitude of tan λ. The measurements, with an accuracy of $\pm 5\%$, have proved that the magnitude of $(\sqrt{\varepsilon}-1)/\rho$, varies very little with different rocks. Under the assumptions that $(\sqrt{\varepsilon}-1)/\rho$ is the same for lunar rocks and the $\varepsilon = 1.5 \pm 0.3$ for the lunar surface, the density of the surface of the Moon is $0.2 \leqslant \rho \leqslant 0.7$. This value is in agreement with density values obtained from other data.

45. Krotikov, V. D., V. A. Porfir'yev, and V. S Troitskiy. Standardizing lunar radio emission at the 3.2-cm wavelength. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 4, no. 4, 1961, 759. .

46. Krotikov, V. D., and V. S. Troitskiy. Detection of heat flux from interior of the Moon. Astronomicheskiy zhurnal, v. 40, no. 6, 1963, 1076-1082.

Precision measurements of lunar radio emission at the NIRFI at wavelengths of 0.4, 1.6, 3.2, 9.6, 35, and 50 cm indicate a gradual temperature increase beneath the lunar surface to a depth of 20 m. A consistent temperature gradient of 1.6 deg/m throughout this layer indicates a homogeneous porous, rather than a dust, structure. The thermal flux, very likely the decay product of radioactive elements, corresponds to that of the earth, viz., $1.3 \cdot 10^{-6}$ cal/cm^2 sec. The total thermal flux from the lunar interior per year amounts to $1.6 \cdot 10^{-19}$ cal; the specific flux, $2.2 \cdot 10^{-7}$ cal/g, is about five times greater than present determinations of the specific flux of the radiogenic heat in stony meteorites (chondrites) and thus invalidates the contention that the Moon is composed of matter similar to chondrites. On the assumption that 50% of the upper lunar layer consists of granite with underlying basalt possessing an abundance of radioactive elements characteristic of terrestrial granites and basalts, it is found that a layer 50-km deep would adequately provide the entire observed lunar flux. This, in turn, indicates a minimum temperature of about 1000K at a depth of 60 km. Apparently, the temperature will not vary at greater depths.

47. Krotikov, V. D., and V. S. Troitskiy. Discovery of the Moon's hot interior. COSPAR. Fourth International Space Science Symposium, Warsaw, Poland, 3-12 June 1963.

An increase in temperature to a depth of about twenty meters beneath the lunar surface has been experimentally determined, indicating that the material composing this layer is in a highly porous state and, consequently, cannot be dust. The heat flux from the Moon's interior was determined to be $1.3 \cdot 10^{-6}$ cal·cm^{-2}·sec^{-1}, the same as that of the Earth. The total heat flux from the lunar interior is about $1.6 \cdot 10^{19}$ cal/yr; the specific heat flux is $2.2 \cdot 10^{-7}$ cal/g. This heat is considered to be the result of the decay of radioactive elements. The concentration of such elements in the lunar material is thus characterized by the specific heat flux.

48. Krotikov, V. D., and V. S. Troitskiy. Lunar radiation at centimeter wavelengths. Astronomicheskiy zhurnal, v. 39, no. 6, 1962, 1089-1093.

Precise measurements of lunar radio temperature at the 3.2-cm wavelength averaged over the disk give a value of 210°K(±5°) for the constant component. Since the radiation of an absolute black Moon at the most probable values of night and day surface temperatures (125 and 391°K) as calculated by the temperature distribution equation $\eta(\psi) = (\cos)^{1/2}\psi$, ψ being the lunar latitude, yields a temperature of 218°K, it follows that at $\lambda = 3.2$ cm the surface of the Moon is almost absolutely black. This can be true in two extreme cases: 1) if hard lunar rock for the 3.2-cm wavelength is very uneven; or 2) if the surface is sufficiently smooth, the rock consists of very porous light material. There is reason to believe that the lunar surface is so smooth that at the 3.2-cm wavelength Fresnel's reflection formulas still hold. From experimental data it follows that 1) the reflection factor of radio emission from the lunar surface at centimeter wavelengths is less than 0.02 at perpendicular incidence, 2) the dielectric constant of the surface material is $1.1 \leqslant \varepsilon \leqslant 1.7$, and 3) its density is $0.2 \leqslant \rho \leqslant 0.89$ g/cm^3. These values are in good agreement with earlier published data.

49. Krotikov, V. D., and V. S. Troitskiy. Radio emission and nature of the Moon. Uspekhi fizicheskikh nauk, v. 81, no. 4, 1963, 589-639.

The article reviews Soviet and non-Soviet radio astronomical investigations, conducted during the past decade, of the temperature, structure, density, and thermal and dielectric properties of the lunar crust. The Soviet investigations were conducted at NIRFI, FIAN, and GAO. The high-precision "artificial Moon" method of measuring radio emission, developed at NIRFI, is described, and a photograph is provided of a 4-m "artificial Moon." The mean temperature on the surface at the lunar equator is 230°K, while the amplitude of the first harmonic is 155°K. Temperature fluctuations are practically nonexistent at a depth of 1.5 m. The temperature increases at 1.6 deg/m down to about 20 m; the density of the thermal flux from the lunar interior is $1.3 \cdot 10^{-6}$ cal/cm^2·sec, the same as that of the Earth. The properties of the upper layer of lunar matter are homogeneous to about 20 m. The density is 0.5 g·cm^{-3}. This layer is porous and has a heat conductivity 40 to 60 times less than that of dense earth rocks. The effective electrical conductivity of lunar matter is $5 \cdot 10^{-3}$ per [illegible]·cm^{-3} [sic], about equal to the losses in good dielectrics. Some 60 -65% of the lunar matter is believed to consist of quartz. The thermal flux given off by the Moon in a year is $1.6 \cdot 10^{19}$ cal. The concentration of radioactive elements is believed to be 5—6 times greater on the Moon than on the Earth.

50. Krotikov, V. D., and V. S. Troitskiy. Thermal conductivity of lunar material from data on precise measurements of lunar radio emission. Astronomicheskiy zhurnal, v. 40, no. 1, 1963, 158-160.

The thermal parameter $\gamma = (K\rho C)^{-1/2}$, in which K is the coefficient of thermal conductivity, ρ is volumetric density, and C is thermal capacity, has been recalculated from recent lunar emission data, resulting in a new value of K for the lunar surface. Three independent methods were used to obtain γ, based on emission temperature data during the lunar day and night and including some infrared return. The three ranges of γ found in this way were 250—450, 250—550, and 300—440, from which a value of 350 ± 75 was considered as correct. With $\gamma = 350$, C = 0.2, and $\rho = 0.5$ gm/cm^3 (the lunar surface density found earlier by the same authors), the thermal conductivity K is found to be $(1 \pm 0.5) \cdot 10^{-4}$ cal/cm/sec/deg, which exceeds the generally accepted value by some 50 times. The new value of K rules out a dust surface for the Moon, and suggests instead porous rock,

possibly somewhat pulverized. The work was done at the Radiophysics Institute of Gorkiy State University imeni N. I. Lobachevskiy.

51. Kuprevich, N. F. Experimental television photographs of the Moon in the spectral region 8000--23000 A. Astronomicheskiy zhurnal, v. 39, no. 6, 1962, 1136-1138.

The results of observations of the lunar surface in the spectral region λλ8000—23000 A with television and an infrared vidicon tube at the Pulkovo Observatory are described. The vidicon was used in combination with an IKS-1 filter, yielding a maximum of sensitivity in the region λ 1.2 μ. An increase in contrast in the photographs is noted with increasing wavelength. It is assumed that the appearance of new details on the lunar image can be explained by a decrease of luminescence radiation in the infrared.

52. Kuprevich, N. F. New information on the structure of the lunar surface. Astronomicheskiy zhurnal, v. 40, no. 5, 1963, 889-896.

Infrared photos of the Moon taken in the 0.8—2.3-μ spectral range at the Pulkovo Observatory by means of an infrared (IR) vidicon with a silicon filter have been found to show a more detailed lunar surface structure than photos of the same areas taken by Kh. I. Potter in the visual region at the Main Astronomical Observatory of the Academy of Sciences USSR. The surface structures of almost all the lunar seas as seen in IR are covered by a complex pattern of intersecting mountain ranges and crater chains. These features are not seen in photos taken in the visual region. IR photography does not support the contention of a dust-covered lunar surface. The heightened contrasts characteristic of IR photos are attributed to 1) a decrease in the luminescence of some formations in IR, 2) a possible increase of the reflecting power of some formations in IR, and 3) the possible presence of scattered light in the visual region of the spectrum, resulting in a masking effect. It is proposed that special television tubes be developed to permit lunar photography in the 2—2.5-μ range and higher, i. e., in the region where there are windows of spectral transparency in the Earth's atmosphere.

53. Levin, B. Yu., and Ye. L. Ruskol. Survey of current data on the Moon. Voprosy kosmogonii, no. 8, 1962, 109-144.
QB981.V83

TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 11, 1962, 11 A519.

Recent data on the motion, atmosphere, photometric properties, surface temperature, surface layer, relief, origin and thermal history, and internal structure of the Moon are reviewed.

54. Mai, R. Spectrophotometry and color indices of regions of the lunar surface. Die Sterne, v. 37, no. 11-12, 1961, 244.

A description of the work of the Soviet investigator, Teyfel'.

55. Markov, A. V. Investigation of the nature and structure of the lunar surface. IN: Akademiya nauk SSSR. Vestnik, no. 8, 1962, 34-37. AS262.A627

A symposium on lunar studies held at Leningrad in December 1960 gave support to the contention made by V. A. Firsov that the density of the upper layer of the lunar crust is of the order of 0.6 g/cm^3. It is believed that the surface is porous and may extend to a depth of 0.4 m. This would explain the very low heat conductivity and the photometric and polarization peculiarities of reflected moonlight. Troitskiy states that a satisfactory explanation of lunar radio emission requires a density of the upper layer of the crust of 0.5 g/cm^3 to depths of 1—1.5 m. The occurrence of earlier very strong volcanic activity on the Moon has recently been confirmed.

56. Markov, A. V., and D. Ye. Shchegolev. Attempted photometric study of the nature of the details of the surface of the far side of the Moon. Iskusstvennyye sputniki zemli, no. 9, 1961, 48-51. TL.796.I8

57. Mikhaylov, A. A. Major problems in the study of the Moon. Priroda, no. 10, 1962, 7-9. Q4.P8

This popular science article describes the advantages of establishing an observatory on the Moon in order to study 1) the origin of lunar surface formations, and 3) the surface layer of the Moon.

58. Mironova, M. Spectral reflecting characteristics of details of Alphonsus Crater. Astronomicheskiy zhurnal, no. 299, 1962, 14-17.
TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 4, 1963, 4.51.529.

Spectrograms of Alphonsus Crater obtained 23-24 May 1961 in the Main Astronomical Observatory of the Ukrainian Academy of Sciences on the AZT-2 with the ASP-5 spectrograph (dispersion at Hν 23 A/MM) on Kodak Oα-F plates with an exposure of 5^m and 10^m were measured on the MF-4 microphotometer. The central peak, the western and eastern walls, and the crater bottom to the west of the central peak were investigated. The indices of yellowness of these details were 0.27, 0.26, 0.18, and 0 .15, respectively. The curves of the spectral reflecting power of the crater details are shown graphically. Comparison of the curves obtained with analogous curves for 47 sample rocks (J. Wilsing and J. Scheiner) showed similarities with basalt and basaltic tuff.

59. Mohacsi Bela. On the formation of the surface of the Moon. Magyar tud akad. Mat. es fiz. tud. oszt. kozl., no. 4, 1960, 421-439.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 7, 1962, 7 A527.

The hypothesized formation of lunar craters by the bursting of gigantic gas bubbles rising from molten magma to the surface is discussed. An approximate relationship between the depth of bubble origin and the radius of the crater is derived. The author believes that the bubble hypothesis can explain all basic characteristics of the lunar relief.

60. Neyman, V. B. On the nature of basic lunar formations. IN: Vsesoyuznoye astronomo-geodezicheskoye obshchestvo. Byullenen', no. 30, 1962, 28-32.

A hypsometric lunar map is compiled in which the isolines correlate better with the visible relief than is the case in the Shrutka-Rechtenstamm map. A tidal bulge is clearly seen in the center of the visible disk. Maximal heights of 4—5 km over the lunar sea levels are seen.

61. Orlova, N. S. Slope angles of loose materials and hypotheses on the dust nature of the lunar surface. IN: Leningrad. Universitet. Uchenyye zapiski no. 307: Seriya matematicheskikh nauk, vyp. 6 (Astronomicheskaya observatoriya. Trudy, v. 19), 1962, 179-186. AS262.L422

Gold's hypothesized dust-covered lunar surface is rejected, on the basis of photometric and surface configuration measurements. Laboratory measurements were first made of the angle of repose of sand, dust, volcanic ash, and other such loose materials. Most were found to have an angle of repose of 25—30°; the greatest value, 45°, was found for powder clays and loess. The slope angles were then determined for terrestrial volcanoes; most were found to be from 30 to 35°. In no case did the slope angle exceed 45°. Photometric measurements were then made of models (4-sided and 3-sided pyramids with 45° slope angles) but none were found to resemble those of the actual lunar surface. It is concluded that if under lunar conditions (less gravity pull, absence of atmosphere, etc.) the natural angles of repose of loose materials is the same as on the earth, then it would be impossible for any sizable portion of the lunar surface to be so covered.

62. Polozhentseva, T. A. On the state of Alphonsus Crater before the onset of the eruption of 3 November 1958. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 3, 1961, 46-49.

Reexamination of the spectrograms of Alphonsus Crater obtained by Kozyrev and Yezerskiy on 3 November 1958 invalidates the conclusion that an ejection of volcanic ash dust occurred several hours before the outgassing. Further, the difference between the energy distribution in the spectrum of the western wall and of the region beyond it and the energy distribution in the spectrum of the central peak can probably be attributed to differences in the spectral reflecting power of these regions.

63. Ruskol, Ye. L. On the original of the Moon. II. The formation of the Moon in the circumterrestrial swarm of satellites. Astronomicheskiy zhurnal, v. 40, no. 2, 1963, 288-296.

Urey's hypothesis to the effect that the Moon was captured after it had already been formed is criticized. The author shows that a swarm of satellites had been formed around the Earth during

its period of growth (100—200 million years) during which 99% of the lunar mass was formed. The satellites were formed due to nonelastic collisions of solid bodies with dimensions up to 10—100 km. It is further shown that the density of the satellite swarm must have increased strongly in the direction of the Earth and that the most massive of them must have been formed at small distances from the Earth. It is concluded that the Moon developed chiefly at a distance of 5—10 Earth radii and that its subsequent removal was due to tidal friction.

64. Salomonovich, A. Ye., and B. Ya. Losovskiy. Observation of the distribution of radio brightness on the lunar disk at 0.8 cm. Astronomicheskiy zhurnal, v. 39, no. 6, 1962, 1074-1082.

65. Solomonovich, A. Ye. Thermal radio emission of the Moon in the centimeter range and some characteristics of its surface layer. Astronomicheskiy zhurnal, v. 39, no. 1, 1962, 79-86.

The results of investigations of lunar radio emission in the cm range, employing the use of the 22-m radiotelescope of the Lebedev Physics Institute, are discussed. At 0.8, 2, and 3.2 cm a two-dimensional brightness temperature distribution as well as an increased darkening of the kisk towards the poles was noted. Values for the effective dielectric penetration factor of the emitting layer and the latitudinal heating distribution of the lunar surface were estimated. The frequency variation curve of the relationship between the depths of radiowave and thermal wave penetration attests to an almost homogeneous layer composition and supports the use of homogeneous models. The small value of the effective dielectric penetration factor and the relatively high, though smaller than thought earlier, value of $(k\rho c)^{-1/2}$, where k is the heat conductivity, c is the specific heat capacity, ρ is the effective density of the layer, attests to a low density of the emitting layer, apparently decreasing towards the surface.

66. Sharonov, V. V. Visual colorimetric investigations of the lunar surface. Astronomicheskiy zhurnal, v. 39, no. 1, 1962, 87-92.

Measurements of the color of 115 details of the lunar surface were carried out with the blue wedge of the Rozenberg astronomical photometer mounted on the visual telescope of the normal astrograph of the Tashkent Astronomical Observatory.

For the absolute standardization, observations were made on a white scattering screen illuminated by direct rays from the sun. This made it possible to express the color of each measured object in the form of the difference $D = C_{\lambda} - C_{\odot}$ of the color indices for a lunar formation C_{λ} and for solar radiation $C_{\odot}$. For the average $D = +0.344$, the extreme values are $+0.290$ and $+0.400$. Thus, the extremal color difference on the Moon, taking into account measurement errors, is ± 0.055 of a unit of the light index. This only slightly exceeds the mean square error in the determination of D, equal to $\pm 0^{m}.038$. Comparing D with albedo ρ shows that with the transition to lighter objects the values of D on the average increase somewhat, while their dispersion decreases. In general, the color differences on the lunar surface are extremely insignificant; they are recognized (though with difficulty) in the seas and are almost indiscernable in the continents.

67. Shemyakin, M. M. Notable chains of lunar craters. Priroda, no. 2, 1962, 100-101. Q4.P8

The region near Clavius is examined in detail.

68. Shemyakin, M. M. On some regularities in the distribution of craterlet chains in the regions of the Clavius and Hipparchus cirques. IN: Vsesoyuznoye astronomo-geodezicheskoye obshchestvo. Byulleten', no. 30, 1962, 33-38. QB1.V752

Certain geometric patterns are noted in the distribution of craterlet chains that could not in all probability have been caused by random meteorite fall. The age of the craterlets is estimated from the size.

69. Soboleva, N. S. Measurements of the polarization of lunar radio emission at the 3.2-cm wavelength. Astronomicheskiy zhurnal, v. 39, no. 6, 1962, 1124-1126.

In August, 1961, linear polarization of lunar radio emission was detected at the 3.2-cm wavelength by the Radio Astronomy Section of the Main Astronomic Observatory, using the large Pulkovo radio telescope with a direct amplification receiver equipped with three traveling-wave tubes. The radiation pattern was 1' x 40', and the elevation, 10°. The percentage of polarization was found

to depend only on the value of dielectric constant ε and the angle between the direction of the normal to the surface and the direction toward the observer. Polarization curves which take into account the roughness of the lunar surface show that the best agreement with experimental data occurs when $\varepsilon = 1.65$, angle of radiation scattering = 40°, and lunar temperature distribution follows the equation $\eta^2 = \cos \psi$, where ψ is the lunar latitude.

70. Soboleva, N. S. On polarization of thermal radioemission from the Moon and planets. Fourth International Space Science Symposium, Warsaw, Poland, 2-12 June 1963.

Observations of lunar polarization in the Pulkovo Observatory began in 1961 at 3.2 cm and were continued in 1962 at 6.4 cm. A comparison of the observed and expected drift curves of polarized emission is made. The observed percentage of polarization at 6.4 cm is found to be slightly higher.

71. Sytinskaya, N. N. Photometric and colorimetric comparison of some porous and dense rocks of volcanic origin with the lunar surface. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 2, 1960, 59-64.

Various volcanic rocks were compared with respect to color and brightness with objects of the lunar surface. It was concluded: 1) Volcanic slag with an average brightness factor r = 0.060 is the darkest type rock. 2) The average findings for slag resembled the values for the fused crusts of meteorites. 3) All rocks of basic composition (diabase, basalt, gabbro, etc.) show average values of r = 0.141 and D = -0.04. 4) Ultrabasic rocks on the average show values of r = 0.104, D = -0.006. 5) Brightness studies show that lunar continents are covered with ultrabasic rocks and the lunar seas with volcanic slag. However, there is no adequate correlation in color. 6) With respect to brightness, pumice stone is not at all similar to the lunar surface. 7) Volcanic tuffs contain specimens of different coloration — from black to light gray and from bluish to red. 8) It would be desirable to extend the investigations to loosely consolidated pyroclastic rocks (volcanic ash, sand, lapilli, etc.).

72. **Sytinskaya, N. N.** Probable dimensions of irregularities in the microrelief of the lunar surface. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 1, 1959, 81-84.

The size of the irregularities in the lunar microrelief have been estimated by comparing the character of the reflection of radiant energy from the surface in the optical and decimeter ranges. It is concluded that the majority of the values of the diameter of lunar microrelief details are significantly smaller than the radio wavelengths. It is believed that the dimensions of the elements of the lunar microrelief are 0.1—10 cm.

73. **Teyfel', V. G.** Color properties of the lunar surface from observations near true full Moon. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 3, 1961, 56-67.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 6, 1962, 6 A483.

The normal color indices of 1442 sectors of the lunar surface were determined from spectrograms of 62 lunar regions obtained on 16—17 September 1959 at phase angles from 4°33' to 3°46'. Taking into account random errors the amplitude of the differences of the color indices is not more than $0^m.25$. The existence of a color-brightness relationship for details of the lunar surface is confirmed.

74. **Teyfel', V. G.** Some ideas on the state of the lunar surface. IN: Akademiya nauk Kazakhskoy SSR. Sektor astrobotaniki. Trudy, v. 8, 1960, 165-170. QK1.A35866

The author advances a hypothesis, according to which the color-brightness relationship observed on the Moon, is the result of both the action of exogenic processes leading to the fusion of different rocks and the subsequent accumulation of the products of the lunar surface under the action of meteorites and other exogenic factors. The following simplified assumptions are made: 1) The continents and mountainous regions on the Moon consist chiefly of acid rocks, while the seas consist of dark basic rocks; 2) The substance obtained under the action of meteorites is a combination of the parent rock and some additional matter that is the same for continents and seas. With these data the optical properties of the lunar surface is computed, and the results obtained are compared with observational data. This leads the author to conclude that

only in the early period of lunar history are the rocks comparable to terrestrial acid and basic magma rocks with respect to optical properties. In subsequent periods of lunar history the differences of brightness and color of the parent lunar surface were smoothed by the action of endogenic processes. The influence of meteorites and other exogenic factors led to a further lowering of the color-brightness contrasts and to the formation of the reddish tint that is characteristic of the entire lunar surface.

75. Teyfel', V. G. Spectrophotometry of the surface of the Moon. II. Catalog of color indices of lunar objects. IN: Akademiya nauk Kazakhskoy SSR. Sektor astrobotaniki. Trudy, v. 8, 1960, 130-151. QK1.A35866

Estimates of the color of a large number of small details are made, using spectrograms of regions of the lunar surface. The method and results of determining the color indices of 262 small sectors of the lunar surface are described. It is found: 1) Small details of the lunar surface studied by means of photometric profiles of spectrograms do not show differences in color larger than those observed in relatively large lunar objects. 2) The color contrasts on the lunar surface are not great and for normal color indices yield differences not exceeding $0.^{m}21$. 3) Normal color indices of lunar objects are restricted to $+0.^{m}76$ -$(+0^{m}97)$. The color index of the reference star α Aur is $+0.^{m}82$. 4) A direct relationship was detected between CE and log I_{550}, even though the ratio of these values expressed conditionally by a gradient differs for different regions.

76. Teyfel', V. G. Spectrophotometry of the surface of the Moon. IN: Akademiya nauk Kazakhskoy SSR. Sector astrobotaniki. Trudy, v. 8, 1960, 152-164.

Some 610 spectrograms of 90 sectors of the lunar surface were processed. On the basis of the spectrophotometric and spectrocolorimetric data it is concluded that the color contrasts of the surface cover of the Moon are very small, although they can be detected by means of multiple measurements of the color of each separate object. The spectral differences of the lunar objects are no more noticeable than the colorimetric and are only seen in small changes of inclination in the spectral curves.

77. Troitskiy, V. S. New method for calculating the density of lunar surface rock. Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v. 5, no. 5, 1962, 885-891.

A method is given for determining the density of lunar surface rock by means of its thermal parameters, as opposed to previous methods based on its electrical properties. The lunar rock is assumed to be similar to one of the types found on Earth. Examples are given of the calculation of two such types: 1) loose or granular, and 2) porous. The density ρ of the lunar rock is determined from the equation

$$\gamma(\rho) = [k(\rho)\rho c]^{-1/2},$$

where γ is a general density function, k is thermal conductivity, and c is thermal capacity. The values of γ and c are known from lunar observations, $k(\rho)$ is evaluated for Earth rock of the pertinent type, and the results are extrapolated to lunar conditions. From these data ρ can be determined. It is shown that over a sufficient interval $k(\rho)$ for terrestrial rock is linear; since lunar rock density lies in this interval, $k = \alpha\rho$ for both types of Earth rock formation. The constant α is then reduced by a factor of 3 for the porous rock and 12 for the granular type to account for the reduced thermal conductivity of rock interspaces in the lunar atmosphere. With $k(\rho)$ known and $\gamma = 350 \pm 75$ the densities are found to be 0.4 ± 0.1 g/cm^3 for the porous rock and 0.9 ± 0.2 g/cm^3 for the granular. The first value is closer to that found from electrical measurements, showing that the porous form is the more probable. While the above assumptions make the results inexact, it is stated that with more reliable thermal data on terrestrial rock, particularly in vacuum, this method will give more accurate information on lunar surface structure than can be obtained by radio measurements.

78. Troitskiy, V. S. Nature and physical state of the upper cover of the Moon. Astronomicheskiy zhurnal, v. 39, no. 1, 1962, 73-78.

As a result of investigations of lunar radio emission at the 0.4 and 3.2-cm wavelengths, it has been shown that the generally accepted model of a two-layered structure for the upper cover indicating the existence of a thin nonthermally conducting layer covering dense lunar rocks and transparent to radiowaves does not agree with data on lunar radio emission and should be rejected.

79. **Troitskiy, V. S.** Radio emission of the Moon, the physical state and nature of its surface. IN: Akademiya nauk SSSR. , omissiya po fizike planet. Izvestiya, no. 3, 1961, 16-30.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 10, 1962, 10 A285.

On the basis of investigations of the radio emission of the Moon at the 0.4- and 3.2-cm wavelengths, it was shown that the commonly accepted two-layered model of the structure of the upper cover indicating the existence of a thin nonthermal-conducting layer covering dense lunar rocks and transparent for radio waves, is not supported by data on lunar radio emission and must be rejected. The character of the dependence of the lunar radio emission on the wavelength definitely indicates a quasi-homogeneous upper cover at least to a depth of approx 1 m. It is concluded that the average composition of lunar surface rocks is analogous to the average composition of terrestrial rocks and that lunar rock cannot contain any significant admixtures of powdered metal, e. g. , meteoritic iron. It has been shown that the value $\varepsilon \operatorname{tg} \lambda / \rho$, measured directly for lunar rocks and equal to 88.10^6 $\gamma c(\operatorname{tg} \lambda$ is the angle of losses, ε the dielectric constant, ρ the density, c the heat capacity of the lunar rock, $\gamma = (k \rho c)^{-1/2}$), is suitable to compare terrestrial and lunar rocks with respect to their electric properties. The optical properties of lunar and terrestrial volcanic rocks are compared. It is shown that porous lunar rocks with a density of $\rho \sim 0.5$ g/cm^3 (dielectric constant, approx 1.5) best correlate with terrestrial rocks.

80. **Troitskiy, V. S.** Radio measurement of the dielectric penetrability and density of the material comprising the upper lunar cover. Astronomicheskiy zhurnal, v. 38, no. 5, 1961, 1001-1002.

The importance of measurements of the dielectric penetrability of the upper soil layer of the Moon is determining the density of the matter of the surface cover is ' 'ed. It is assumed that its composition is analogous to that of the Earth's crust. A method is proposed for measuring ε, based on the measurement of the radio emission phase lag from sectors of the disk located at different longitudes ψ along the lunar equator in comparison with the phase of heating for the same area. If $\varepsilon \sim 1$ and the emission proceeds from a depth 1 for the center of the disk, then from another sector on the equator the emission comes from depth 1 cos φ. Near the limb, the depth is small and the radio emission phase lag will be considerably less than in the

center of the disk. If, however, $\varepsilon >> 1$, then the effect of a strong refraction of depth waves (and subsequently phase shifts) for the center and the limb will be about the same. The most suitable wave range for such measurements is the millimeter wave range.

81. Yezerskiy, V. I., and V. S. Opryatova. Ultraviolet spectrophotometry of the surface of the Moon. Astronomicheskiy tsirkulyar, no. 224, 1961, 16-17.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 3, 1963, 3.51.478.

Observations were made at the Kharkov Astronomical Observatory in 1958 and 1961 with a quartz spectrograph and a coelostat. Comparison with sunlight and a photometric calibration were performed by means of a barium screen and a diaphragm system. After introducing corrections for atmospheric extinction and screen selectivity, values are obtained for the logarithms of the relative values of the spectral reflecting power of the Moon for the λλ 3200-4100 spectral sector, the variation of which with wavelength is given in graphic form. A strong falloff of the reflecting power towards the ultraviolet, beginning at λ 3700, is detected.

82. Barabashov, N. P. Dust formations in the atmosphere and the color of the seas of Mars. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 26, 1963, 3-13. TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 7, 1964, 7.5.446.

On the basis of analysis of photometric observational data of Mars in 1939, 1954, 1956, and 1958, the effect of the presence of yellow haze on the brightness distribution of the planetary disk and on the continent-sea contrast has been studied. In the presence of a yellow haze the distribution of brightness on the disk, characterized by the ration of the values of the brightness factor in the center ($\varepsilon \approx 0°$) and on the limb ($\varepsilon \approx 60°$), changes spectrally considerably less than in the case of a transparent atmosphere. Examination of the variation of the brightness factor spectrally for individual sectors of the seas under different Martian atmospheric conditions has shown that it is possible to define three characteristic groups. To the first group belong seas which, with regard to spectral reflectivity, differ little from the continent adja ent. To the second group belong seas having a sharp break in the brightness factor line in the spectrum after which, in the shorter wavelength region, they are comparable in reflectivity to the neighboring continent. To the third group belong seas whose brightness factor after the break run somewhat higher than the corresponding curve for continents, gradually blending with it near 3600 Å.

83. Barabashov, N. P. Physical conditions on Mars. IN: Akademiya nauk SSSR. Vestnik, no. 10, 1962, 18-25.

Soviet and Western findings with respect to the surface and atmosphere of Mars are reviewed. Photometric studies in the red and near infrared light show that the brightness distribution of the Martian disk from the center to the edge resembles that yielded by Lambert's light reflection law, which holds for ideally dull surfaces with irregularities smaller than 0.1 mm. The Martian atmosphere is believed to possess chiefly scattering properties. The pressure has been estimated at 6—8 cm Hg. Spectral, photometric, and polarization characteristics suggest that the Martian surface is composed of rocks resembling terrestrial reddish fragmented volcanic tuffs as well as limonite,

ochra, and reddish sandstone. It is thought that the Martian seas and continents may be composed of the same rock but in different stages of oxidation. Kozyrev, on the other hand, maintains that the reddish color of Mars is the exclusive product of the atmosphere in which absorption predominates over scattering. The Astronomical Observatory of Kharkov University has ascertained that the surface of the Martian seas is more irregular and rougher than that of the continents. On the basis of pressure and density estimates, it is thought that at a height of 28-km propeller-driven aircraft could operate in the Martian atmosphere, and that such craft would be able to climb to greater heights than on earth. It is believed that the polar caps are not solid but are interrupted by patches of the reddish surface. The caps consist of two components: the surface component of snow or frost and the atmospheric component of fog or light clouds.

84. Barabashov, N. P. ed. IN: Rezul'taty nablyudeniy Marsa vo vremya velikogo protivostoyaniya 1956 g. v SSSR (Results of observations of Mars made during the great opposition of 1956 in the USSR). Moskva, Izd-vo AN SSSR. Kommissiya po fizike planet, 1959. 195 p. QB516.A3

This collection of articles describes observations made of Mars during the opposition of 1956. The following articles are included:

1) Observations of Mars made in the USSR in 1956

2) Tikhov, G. A. Brief results of observations of Mars made in the Sector of Astrobotonics during the great opposition of 1956

3) Barabashov, N. P., and I. K. Koval'. Photographic photometry of Mars with light filters

4) Sytinskaya, N. N. On the photometric investigations of the optical properties of the Martian atmosphere

5) Sharonov, V. V. Surface and atmosphere of Mars based on photographic, photometric, and colorimetric observations made in 1956 in Tashkent

6) Sharonov, V. V. Experience in determining the contrasts on the Martian disk through visibility measurements

7) Sytinskaya, N. N. Some ideas on the state of the Martian atmosphere

8) Bronshten, V. A. Visual observations of Mars during the great opposition of 1956

9) Bronshten, V. A., and O. B. Dluzhnevskaya. Photographic photometry of the bright region of Argyre on Mars in the end of August 1956.

85. Barabashov, N. P., and I. K. Koval'. Fotograficheskaya fotometriya Marsa so svetofil'trami v 1956 g. (Photographic photometry of Mars with light filters in 1956). Kharkov, Izd-vo Khar'kovskogo gosudarstvennogo universiteta, 1959, 531 p. QB516.B245

The methods and results of investigating Mars at the Kharkov Astronomical Observatory during the great opposition in 1956 are presented. All of the material on the absolute photometry of Mars as well as some of the results of visual observations of its surface are given.

86. Barabashov, N. P., I. K. Koval', and A. T. Chekirda. Photometric observations of Mars in 1958. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 3, 1961, 3-15.

Photometric observations of Mars were made from September through November 1958 on the 270-mm reflector of the Kharkov University Astronomical Observatory. No correlation was seen between the data for contrasts in red and blue light for points lying within the aerographic longitudes of 90—200°.

87. Bronshten, V. A. Atlas risunkov Marsa (Atlas of Sketches of Mars). Moskva, Izd-vo AN SSSR. 1961, 119 p.

The Atlas contains 474 sketches of Mars made during the opposition of 1956. Part I of the Atlas consists of sketches with accompanying footnotes indicating time of observation, observer, diameter of reflector, type of filter, image quality, etc. Part II consists of the observer' remarks. An overlay grid is included for coordinate measurements.

88. Bronshten, V. A. On the question of the photographic photometry of Mars at great phase angles. IN: Akademiya nauk SSSR. Vsesoyuznoye astronomo-geodezicheskoye obshchestvo. Byulleten', no. 32, 1962, 15-22.

To determine the basic optical parameters of the Martian surface and atmosphere, viz., brightness r, smoothness factor q, and optical thickness of the atmosphere τ, observations were made near opposition when the phase angle of the planet $\xi \leqslant 9.5$. Brightness r is a function of three parameters: the angle of incidence i, the angle of reflection ε, and the azimuth of the reflected light a. Several methods are proposed to clarify the function r(i, ε, a). The form of the function for each value of i can be expressed by a geometric surface, an indicatrix of scattering. The Department for the Study of the Planets and the Moon, Moscow Branch of the All-Union Astronomical and Geodetic Society, is reported to be making model experiments to explain the dependence of r on angles i and ε at different phase angles ξ and different degrees of surface roughness.

89. Ibragimov, N. B. Preliminary results of the integral spectrophotometry of Mars. IN: Kharkov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 26, 1963, 37-42.
TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 7, 1964, 7.51.447.

As a result of spectrophotometric observations of Mars made with the ASP-9 spectrograph and AZT-7 telescope in the period September 1960 through May 1961, values of monochromatic stellar magnitudes of Mars for 20 wavelength values in the Greenwich monochromatic stellar magnitude system were determined. Examination of the phase coefficient variation along the spectrum has shown that, besides a general lessening with an increase of wavelength, a minimum occurs near λ5250. The dependence of the color index on the phase angle was also defined. It may be represented by the relationship

$$C\lambda_1\lambda_3 = 1^m.48 + 0.009\alpha,$$

where λ_1 = 4250 Å and λ_3 = 5550 Å.

90. Kotel'nikov, V. A., V. M. Dubrovin, B. A. Dubinskiy, M. D. Kislik, B. I. Kuznetsov, G. M. Petrov, A. P. Rabotyagov, O. N. Izhiga, and A. M. Shakhovskoy. Radar observations of the planet Mars in the Soviet Union. IN: Akademiya nauk SSSR. Doklady, v. 151, no. 4, 1963, 811-814.

Radar observations of Mars' northern hemisphere from 14°30' to 14° latitude and from 310 to 360° and from 0 to 140° longitude were carried out in the Soviet Union on 6—10 February 1963 at a frequency of approximately 700 Mc.

91. Koval', I. K. Distribution of brightness in the edge zone of Mars. COSPAR. Fourth International Space Science Symposium. Warsaw, Poland, 3-12 June 1963.

During the 1963 opposition with Mars photoelectric observations were made with the 28" reflector at the Main Astronomical Observatory of the Ukrainian Academy of Sciences. The cross-section method in ten spectral bands in the 355-900 mμ range was employed. Average distributions of brightness of up to 0.95 R° were obtained along the visible diameter of Mars. It was seen that the steepness of the brightness curves increases from 355 to 600 mμ and remains constant for greater wavelengths.

92. Koval', I. K. On the degree of smoothness of the continents and seas of Mars. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 1, 1959, 85-92.

Changes in the continent-sea contrast from the center to the limb of the Martian image were studied on the basis of photos obtained through the use of red and infrared light filters. The contrast on the surface of Mars is seen to decrease towards the limb of the disk. The images of Mars obtained in 1954 are held to be most satisfactory in determining the light reflection from continents, while those obtained in 1956 are most suitable for studying the seas. The brightness distribution on the Martian seas differs from that on the continents.

93. Koval', I. K., and A. V. Morozhenko. On some properties of the yellow haze observed on Mars in 1956. Astronomicheskiy zhurnal, v. 39, no. 1, 1962, 65-72.

Contrast studies between light and dark Martian regions are used to determine the approximate values of the optical thickness τ_λ

of the "dust cloud" for the red and infrared rays. On the basis of the values of τ_λ found, the radius of the particles comprising the dust cloud is found to be 1.45 μ . Using Stokes' formula for the rate of settling of such particles in the atmosphere, the authors obtain approximate data characterizing the time of particle settlement from different heights and given particle density. It is found that for particle densities not exceeding three, the time of settlement from a height of 1 km is not less than 40 days.

94. Kozlova, K. I., and Yu. V. Glagolevskiy. On the change of Martian color determined from photoelectric observations of 1958. IN: Akademiya nauk Kazakhskoy SSR. Sektor astrobotaniki. Trudy, no. 8, 1960, 121-124.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 1, 1962, 1 A510.

Observations were made in October--November 1958 in Alma-Ata on the AZT-7 telescope and the AFM-3 electrophotometer. The telescope-filters-photomultiplier system yielded an λ_{eff} of 420 and 535 m μ . Capella was used as the comparison star. The difference in the zenith distance of Mars and the comparison star was 0.5—7° . The comparison star and Mars were measured 10 times with each filter. The photoelectric color excess of Mars relative to Capella was computed for each day of observations and presented in a table and graph. As the planet approached opposition the CE values decreased from $0^m.66$ to $0^m.46$ and then began to increase. A comparison of changes of the color index of Mars with phase angle i derived from results obtained in 1956 and 1958 is shown graphically. The CI of Mars as it leaves opposition towards i = 30° increased $0^m.10$ in 1958 and $0^m.27$ in 1956, so that Mars reddens as it moves away from opposition. For each observational day values of the color temperature are given. The changes of CI, CE, and T are considered to be real and are ascribed to changes in the atmosphere and on the surface of the planet as well as to changes in the observed part of the surface caused by Martian rotation.

95. Kozyrev, N. A. Spectral indications of snow in the atmosphere of Mars. COSPAR. Fourth International Space Science Symposium, Warsaw, Poland, 3—12 June 1963.

Comparative spectrophotometric investigations of Martian seas and continents support the contentions that the Martian atmosphere

is opaque to short wavelengths (< 4200 Å) and that the polar caps are mainly an atmospheric phenomenon. The red color of Mars is also believed to be an atmospheric, rather than a surface, characteristic. The polar caps are considered to be a concentration of the same scattering particles that cause Martian atmospheric haze. Since a similar band of scattering was detected in the spectrum of finely powdered dry snow sifted in front of the spectrograph slit, it is believed probable that there are ice needles in the Martian atmosphere similar to those observed in the terrestrial atmosphere when the temperature falls considerably below freezing.

96. Lebedeva, I. I. Measurement of the diameter and oblateness of Mars on the basis of photos obtained in 1956. IN: Akademiya nauk SSSR. Komissiya po fizike planet. Izvestiya, no. 2, 1960, 41-45.

On the basis of photos of Mars obtained during the opposition of 1956 it has been possible to determine the equatorial diameter and the oblateness in the photovisual and the photored systems. The final value of the Martian equatorial diameter, expressed in angular measurement reduced to a distance of one astronomical unit, is: photovisual system 9.13", photored system 8.97", difference 0.16". The values of the equatorial distance expressed in kilometers are photovisual system, 6618 km, and photored system, 6496 km. The final value obtained for the oblateness of Mars is 0.0079 ± 0.0022.

97. Lebedinskiy, A. I., and G. I. Salova. On the amount of free water on Mars. Astronomicheskiy zhurnal, v. 39, no. 3, 1962, 494-505.

The amount of water in the free state on Mars is examined. Estimates are made in two ways: 1) by the degree of atmospheric turbidity, and 2) by the rate of polar cap evaporation. Both methods yield only approximate results. The thickness of the snow or cloud layer in the polar cap areas is 0.01 g/cm^2, the total amount of free water on Mars is 2×10^{15} g. Errors are pointed out in the computations of Vaucouleurs and Janesley.

98. Moroz, V. I. Observations of the infrared spectrum of Mars in the interval 1.1—4.1 μ. Astronomicheskiy tsirkulyar, no. 262, 1963, 4-5.
TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 7, 1964, 7.51.445.

Using the 125-cm reflector of the Shternberg State Astronomical Institute with a diffraction spectrometer, a spectrum of Mars was obtained with a resolution of 400 in the 1.1—2.5 μ region, and with a prism spectrometer with a resolution of 40 in the 2.9—4.1 μ region. A PbS photoresistor, cooled by dry ice and liquid nitrogen, served as the radiation receiver. In the 1.1—2.5 μ region, 12 CO_2 absorption bands, 7 of which were obtained for the first time, were detected. One of the new bands λ 2.10 μ is isotopic. Bands at λ 1.6 μ are less intensive that had been thought earlier, and, consequently, it was necessary to decrease the quantitative concentration of CO_2 in the Martian atmosphere. The relative concentration of CO_2 in the Martian atmosphere, computed from these observations, was equal to $[CO_2] = 33/p^2$, where p is the pressure in the Martian atmosphere in millibars. In the region 2.9—4.1 μ, 4 unidentified bands, λλ 3.43, 3.53, 3.59, and 3.69 μ, 3 of which approximately correspond to Siton's "life bands," were found. On the basis of the absence of bands of other compounds, the upper limits of content in the Martian atmosphere were computed. Thus, $CO < 5$, $NO_2 < 0.1$, $N_2O < 5$, $NH_3 < 1$, $CH_4 < 0.3$, $C_2H_2 < 0.1$, $C_2H_4 < 0.1$, $C_2H_6 < 0.05$. Using the prism spectrometer a polar cap spectrum in the 1.1—2.5 μ region was obtained with a resolution of 10. The author concludes that the polar caps consist of hoarfrost, snow, or ice clouds.

99. Moroz, V. I. Recent observations of the infrared spectra of Mars and Venus (1 - 4μ) in connection with the space investigations problem. COSPAR. Fourth International Space Science Symposium, Warsaw, Poland, 3--12 June 1963.

A CO absorption band at 2.35 μ and several unidentified absorption features have been found in the infrared spectrum of Venus during observations in 1963. A model of the Venusian atmosphere in the region of CO_2 photodissociation was constructed and was determined to be in rough agreement with observed absorption. The Venusian albedo decreases from 2.5 to 2.9 μ. Absorption at $\lambda > 3$ μ is believed to cause the greenhouse effect which heats the planetary surface; however, the constituent which produces

this absorption is still unidentified. Infrared spectral investigations of Mars confirmed the "ice" origin of the polar caps and the presence of Sinton's "bands of life." New CO_2 bands were also found. The equivalent widths of Martian CO_2 bands were observed to be lower than those previously determined by Dr. Kuiper. In addition to the 3.56-μ band identified by Sinton, a second band (3.53 μ) was detected.

100. Morozhenko, A. V. Polarimetric investigations of Mars at the Main Astronomical Observatory of the Ukrainian Academy of Sciences. Fourth International Space Science Symposium, Warsaw, Poland, 2—12 June 1963.

The results of investigations made in eight spectral regions (355-600 mμ) of the polarization phase angle relationship of the Martian disk during the 1962—1963 opposition are given.

101. Perevertun, M. P. Visual observations of Mars in 1958. IN: Akademiya nauk Kazakhskoy SSR. Sektor astrobotaniki. Trudy, no. 8, 1960, 117-120.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 1, 1962, 1 A509.

Visual observations of Mars were made in Alma-Ata from 1 October through 5 December 1959 and on the AZT-7 reflector with red, yellow, green, light and dark blue, and color-contrast light filters (magnification 270 and 400 times). In all, 110 sketches of Mars were made; a detailed record was kept of the atmospheric and light phenomena noted. Visual estimates of the brightness of individual details were made using a 10-unit scale. In order to achieve an objective evaluation of the green and blue shading of the individual seas and polar caps, a simple visual photometer was designed. The basic component was a Lummer-Brodhun cube. Filters were changed with a disk with automatic locator. It was concluded that Solis Lacus has a dark yellow color; the Mare Sirenum, violet; and the Mare Cimmerium, yellow. The brightness of the south polar cap is greatest through the green and yellow filters; it was not possible to detect it through the red. The color of the north polar cap without a filter is light blue; its brightness was greatest in green, yellow, and at times in the blue. A thick fog, covering both polar regions, appeared in the middle of November. The contrast of dark regions with the

continents in the visual and particularly in the green is less than in the red. In the green the central part of the seas was darker than the periphery, while in the yellow the central part is brighter than the edge. It is noted that Syrtis Major and Solis Lacus have a mosaic structure. On the night of 8—9 November a light spot that exceeded in brightness the entire polar cap region was noted in the region of the north pole.

102. Wattenberg, Diedrich. Mars: the red planet. Urania-Verlag, Leipzig/Jena, 1962, 195 p.

A popularized account of all aspects of Mars research, reviewing both Soviet and Western contributions.

103. Yezerskaya, V. A., and N. F. Yeremenko. Spectrophotometry of Mars near the opposition of 1956. IN: Kharkov. Universitet. Astronomicheskaya observatoriya, Tsirkulyar, no. 19, 1963, 27-28.
TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 2, 1962, 2 A467.

Spectrograms were obtained on 4 and 27 September 1956 by means of an objective prism with an angle of 12 on the Merz refractor (D = 110 mm, F = 550 mm, dispersion 340 A/mm at $H\gamma$). FP-4 plates were used; α Aql was chosen as comparison star. The recordograms of the spectra were obtained on the MF-4 microphotometer. Corrections for atmospheric attenuation of the value $\log J_{Mars}/J_{Aql}$ for 322-588 m μ are given in tabular form. The relative distribution of intensity in the Martian spectrum is given in the graph. The color index, computed from the observations of 4 September, is +1.43, while for 27 September, +1.66.

III. Venus

104. Bibinova, V. P., A. D. Kuz'min, A. Ye. Salomonovich, and I. V. Shavlovskiy. Observations of radio emissions of Venus and Jupiter at 3.3 cm. Astronomicheskiy zhurnal, v. 39, no. 6, 1962, 1083-1088.

Observation of radio emissions of Venus and Jupiter were carried out at the 3.3-cm wavelength in 1961 at the P. N. Lebedev Physics Institute, Academy of Sciences USSR, with a 22-m radio telescope. A modulation radiometer with a sensitivity of approx 0.1 K at a time constant of 16 sec was used as a receiver. Measurements of antenna temperature were made by comparing the observed signal with a standard signal of known intensity from a gas-discharge noise generator. The Venus observations were made from 26 May to 10 July, during which period the relative area of the illuminated part of the visible disk varied between 0.33 and 0.6. The mean brightness temperature of Venus, averaged over the disk, was 542 K (±85K). The brightness temperature showed a tendency to increase with the area of the illuminated part of the visible disk, which demonstrates a difference in temperature of the night and day sides of the planet. Radio emissions of Jupiter were observed on four nights between 1 and 10 July. The brightness temperature did not remain constant from day to day, the average being 193 K.

105. Danilov, A. D. Model of the ionospheres of Venus and Mars. Geomagnetizm i aeronomiya, v. 1, no. 3, 1961, 314-319.

On the basis of the examination of photochemical reactions taking place in the terrestrial atmosphere models of the ionospheres of Venus and Mars have been constructed. It is assumed that the atmosphere of Venus consists chiefly of carbon dioxide, while that of Mars consists of molecular nitrogen. It is found that the ionosphere of Venus has ions of CO^+_2, CO^+, and O^+; the maximum electron concentration is of the order of 10^6 electrons/cm^3 located at a height of approx 100 km. The ionosphere of Mars has ions N^+_2 and N^+ with a maximum electron concentration of the order of 10^5 electron/cm^3 at a height of approx 300 km.

106. Idlis, G. M., and S. O. Obashev. On the magnetic field and period of rotation of Venus. IN: Akademiya nauk Kazakhskoy SSR. Astrofizicheskoy institut. Izvestiya, no. 12, 1961, 91-93. QB1.A1737

The most probable period of rotation of Venus is estimated at $T \simeq 14$ days $\simeq 1.2 \times 10^6$ sec. The Venusian magnetic field is estimated to be $\mu \simeq 4 \times 10^{24}$ gs·cm^3.

107. Kotel'nikov, V. A., L. B. Apraksin, V. O. Voytov, M. G. Golubtsov, V. M. Dubrovin, N. M. Zaytsev, E. B. Korenberg, V. P. Minashin, V. A. Morozov, N. I. Nikitskiy, G. M. Petrov, O. N. Rzhiga, and A. M. Shakhovskiy. Radar system used for Venus probing in April 1961. Radiotekhnika i elektronika, v. 7, no. 11, 1962, 1851-1859. TK7800.R4

A special radar system for radar examination of Venus has been developed by the Institute of Radio Engineering and Electronics, Academy of Sciences USSR. The transmitter frequency is approximately 700 Mc and the power flux density, 250 mw/sterad. Polarization is circular for transmission and linear for reception. Transmission frequencies, keying modulation, and receiver local oscillators were crystal controlled to a stability $> 1:10^9$. Frequency corrections were applied during transmission to compensate for the Doppler shift caused by changes in the distance between the Earth and Venus and by the Earth's rotation. Carrier modulation was by telegraphic-type pulse trains with pulse durations of 128 or 64 msec. Transmission was made at 5-min. intervals. The return signals were heterodyned to 750 cps and recorded on tape by using a passband of 420—1020 cps. A 2-kc signal was recorded simultaneously as a time base. The start of this timing-signal recording, controlled by the master timer, coincided within 1 msec with the calculated arrival time of the reflected signal. This permitted comparison of calculated and actual transit time of the signal to Venus and back. The taped signals were then analyzed by playback through a bank of filters having a bandwidth of 4 or 60 cps. The presence of the signal was determined by comparing the recorded energy of the receiving interval (signal + noise) to the energy of an equal subsequent interval (noise only). For the transmitter configuration used and for a signal-to-noise ratio of 1 at the analyzer output, the power flux density was 5×10^{-23} w/m^2 with the 60-cps and 1×10^{-23} w/m^2 with the 4-cps filter.

108. Kotel'nikov, V. A. (Academician), V. M. Dubrovin, B. A. Dubinskiy, M. D. Kislik, B. I. Kuznetsov, I. V. Lishin, V. A. Morozov, G. M. Petrov, O. N. Rzhiga, G. A. Sy*tsko, and A. M. Shakhovskoy. Radar observations of Venus in the Soviet Union in 1962. IN: Akademiya nauk SSSR. Doklady, v. 151, no. 3, 1963, 532-535.

From 20 October to 21 December 1962, radar observations of Venus were made, each of a duration of 4.5 to 7 min. The radar employed was the same used in 1961 observations but with its sensitivity improved by a factor of 6 by means of a paramagnetic ruby amplifier placed at the receiver input and through an increase in transmitter power.

109. Kotel'nikov, V. A., V. M. Dubrovin, M. D. Kislik, Ye. B. Korenberg, V. P. Minashin, V. A. Morozov, N. I. Nikitskiy, G. M. Petrov, O. N. Rzhiga, and A. M. Shakhovskoy. Radar observations of Venus. IN: Akademiya nauk SSSR. Doklady, v. 145, no. 5, 1962, 1035-1038. AS262.S3663

Radar observations were made in 1961 using a set operating at about 700 Mc/s. Power density was 250 mw/steradian, or 15 wt on the planet the receiving antenna was linearly polarized. The transmitted signal was in the form of rectangular pulses 128 or 64 μ sec in duration, separated by gaps of the same duration. Corrections were made for Doppler displacement caused by changes in the distance between the Earth and Venus. The signal required about 5 min to travel to Venus and back. The value of the astronomical unit was determined by Doppler displacement of the spectrum of the narrow band component and by the lag of the reflected signal. The value obtained by the former method was 149,598,000 km with a mean square error of 3,300 km; the value obtained by the latter method was 149,599,300 km with a mean square error of 570 km. The broad-band component was noted for the first time and studied. It is concluded that the rotation period of Venus is either 9—10 days or more than 100 days.

110. Kotel'nikov, V. A., V. M. Dubrovin, V. A. Morozov, G. M. Petrov, O. N. Rzhiga, Z. G. Trunova, and A. M. Shakhovskoy. Results of Venus radar probing, 1961. Radiotekhnika i elektronika, v. 7, no. 11, 1962, 1860-1872. TK7800.R4

Data is given on radar reflections received from the Venus probe in April 1961; transmitted frequency was about 700 Mc. Spectral

analyses of the reflected signals show that they include narrow-band components. The former component was limited to 4 cps and was nearly constant in amplitude during observation. From the narrow-band reflections, the reflection factor of Venus was calculated to be 0.08 when referenced to the radiation source in Cassiopeia A. The narrow-band data were also used to recalculate the value of the astronomical unit as 149,599,300 km with an rms error of 580 km. The spectrum of the wide-band fluctuating component of the reflected signal extended to at least 400 cps, while its amplitude varied considerably. It is suggested that if the surface area and variations are caused by smoother than of the Moon, the wide-band variations are caused by reflection from the entire illuminated area and by a Doppler shift which is due to the planet's rotation, while the narrow-band reflections come from a small area of the surface nearest the Earth. This hypothesis yields a rotation period of 11 days for Venus if its axis is normal to the Earth-Venus line of sight, less if its axis is inclined. However, if the reflective properties of Venus are the same as those of the Moon, then the narrow-band data must be used to account for planet rotation, and the calculated period exceeds 100 days.

111. Kozyrev, N. A. Night airglow of the lower layers of the Venusian atmosphere. Astronomicheskiy tsirkulyar, no. 225, 1961, 4-6. TAKEN FROM: Referativnyy zhurnal. Astronomiya, no. 1, 1963, 1.51.472.

Continuing the investigations of the emission on the dark side of the Venusian disk, which have been conducted since 1953 on the 50" reflector of the Crimean Astrophysical Observatory with a quartz spectrograph (dispersion between H and K is 110 Å/mm) the author obtained spectrograms of the planet in May—June 1956, October 1959, and March 1961. The emission spectrum on them did not come out, but the contour of line K in the spectrum of the dark part of the planetary disk was obtained narrower and deeper than in the spectrum of the sky outside the disk. The author believes that the atmosphere of the planet emits a self-radiation which is added to the sky background. The depth of the contour of line H was slightly diminished symmetrically. Because of the nonsymmetrical narrowing of line K, the distances between lines H and K on on the Venusian disk are $6\,\mu \pm 2\,\mu$ greater than in the sky outside the disk. Photometric sections in the region of H and K led to the conclusion that the source of emission was in the absorbing layers of the atmosphere, possibly in the cloud layer. Reduction of two

spectrograms yielded a graph of the night emission of the Venusian hemisphere as a function of wavelength, showing the presence of belts resembling the emission of formaldehyde. The intensity of the Venusian night airglow was 2×10^{-6} of the day illumination on the earth or approx 2 erg/cm sec. Possible mechanisms causing the emission are discussed.

112. Kupo, I. D. On a method of daytime spectrography of Venus. IN: Akademiya nauk Kazakhskoy SSR. Astrofizicheskiy institut. Izvestiya, no. 15, 1962, 111-116.
TAKEN FROM: Referativnyy zhurnal, Astronomiya i geodeziya, no. 6, 1963, 6.51.474.

From March through October 1959, 348 photos of the spectrum of Venus were obtained in the daytime, using a slit spectrograph (dispersion 140 A/mm at Hγ) mounted on an AZT-7 8" telescope. These observations did not confirm the systematic differences in the color of the planet at different phase angles noted by Barabashov and Yezerskiy. The observational data do support the findings of Sharonov according to which there is no relationship between the color and phase. Some vacillations in the color of the planet were detected which may be connected with changes in the intensity of solar activity. However, there is not enough material at present to study this question in detail. Arguments in favor of daytime observations of Venus are advanced and notes on future observations given.

113. Kuz'min, A. D., and A. Ye. Salomonovich. Direction and period of Venus' rotation. Astronomicheskiy zhurnal, v. 40, no. 1, 1963, 154-157.

A method is described for determining the period and direction of Venus' rotation from short-term variations in the brightness and temperature of the disk, as distinguished from long-term (synodic) variations. The data used consisted of existing records of 8- and 3.3-cm emission from Venus during a 110-day period. To establish a statistical correlation of temperature variations, the time relationship was assumed to be the sum of a periodic function with period T, for which the autocorrelation coefficient $R(\tau)$ would be maximum for $\tau = nT$ ($n = 1, 2, 3, \ldots$). From recorded data, $R(\tau)$ had a maximum of 0.75 for $\tau = 72$ days, which was thus taken to be the synodic rotation period for Venus; correction for

Earth's motion then gave 69 days as the true rotational period. From this it is shown that 1 Venusian day ≅ 100 Earth days. In determining the rotational direction, it was noted that from Earth the apparent synodic motion of Venus would decrease at inferior conjunction and increase elsewhere if the planet had a positive rotation; if, however, the motion were retrograde, the reverse would be true. The temperature observations agreed with the former case, indicating positive rotation. The discontinuous nature of returns over the area of the disk of Venus suggest the existence of continents and oceans. It is suggested that the possibility for error in the method described is great, so results must be verified by further data. This study was carried out at the P. N. Lebedev Physics Institute, Academy of Sciences USSR.

114. Kuz'min, A. D., and A. Ye. Salomonovich. Observations of radio emissions of Venus and Jupiter at the 8-mn wave. Astronomicheskiy zhurnal, v. 39, no. 4, 1962, 660-668.

115. Kuz'min, A. D., and A. Ye. Salomonovich. Radio emission of Venus at 9.6 cm. Astronomicheskiy tsirkulyar, no. 221, 1961, 3-5. TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 2, 1962, 2 A375.

116. Martynov, D. Ya. On the radius of Venus. II. Astronomicheskiy zhurnal, v. 39, no. 4, 1962, 653-659.

A new determination of the radius of Venus is made from observations of the occulatation of Regulus and the analysis of hitherto unused observations. The result is given in the form of tables and graphs. The Auwers value of 8.41" or 6100 ± 30 km was confirmed. A table of possible corrections for this value is given. The Venusian cloud layer is discussed and daily changes in the height of the layer noted.

117. Martynov, D. Ya. Venus. Physical nature of the planet. IN: Moscow. Universitet. Vestnik. Fizika, astronomiya, no. 5, 1961, 23-28. TAKEN FROM: Referativnyy zhurnal. Astronomiya i geodeziya, no. 3, 1962, 3 A482.

Venus research is reviewed and its future prospects are discussed.

118. Moroz, V. I. Infrared spectrum of Venus (1 - 2.5). Astronomicheskiy zhurnal, v. 40, no. 1, 1963, 144-153.

In 1961-1962 observations were made of Venus in the 1 - 2.5 range with a diffraction spectrograph and lead-sulfide photoconductive cell attached to the 122 and 125 cm reflectors. The observational data, a list of identified and unidentified details, and a summary of recent data on the chemical composition of the Venusian atmosphere are given in tabular form. The abundance ratio $C^{12}O_2^{16}/C^{13}O_2^{16}$ was estimated and found to be the same as that in the Earth's atmosphere. The spectrum obtained after averaging all the observational data, the monochromatic albedo curve in the 1 - 2.5 μ region, and the integral albedo (estimated at 0.66) are represented graphically. No features characteristic of reflection from ice crystals are seen in the monochromatic albedo curve. Apparently, the clouds consist of neither ice nor water, but dust. The mean radius of the dust particles was found to be about 1 μ.

119. Salomonovich, A. Ye. Concerning the detection of water in the atmosphere of Venus. IVUZ. Radiofizika, v. 7, no. 1, 1964, 51-58.

The possible presence of water vapor and aqueous clouds in the atmosphere of Venus is reassessed in light of recent data on the radio emission from this planet. By assuming an atmosphere consisting of 20 per cent CO_2 and 80 per cent N_2 at a pressure of 90 mb, it is shown first that the radio-emission absorption observed below 3 cm cannot be attributed to the carbon dioxide. Further estimates of the hypothetical cloud layer capable of accounting for the brightness temperature observed at millimeter wavelengths leads to a brightness vs. wavelength curve which approximates the observed data but still exhibits unaccounted for deviations which cannot be reconciled by modifying the assumed parameters of the surface of Venus and its clouds. It is also indicated that no appreciable dips in the radio-emission brightness temperature can be expected near the 13.5-mm water resonance line and that the possible presence of hydrocarbons (CH_2O, C_2H_2O, CH_2O_2) can lead to lines close to those of water. It is concluded that additional information can be obtained by spectral radioastronomy but that the available low-noise amplifiers have too narrow a bandwidth and the recorded antenna temperature of Venus may not be high enough for the conventional broadband amplifier.

120. Verozub, L. V. On the radio emission of Venus in the centimeter range. IN: Kharkov. Universitet. Uchennyye zapiski, v. 122, 1962 (Astronomicheskaya observatoriya. Trudy, no. 14), 86-90. TAKEN FROM: Referativnyy zhurnal, Astronomiya, no. 3, 1963, 3.51.341.

An attempt is made to interpret the observed radio emission from Venus in the centimeter wave range. The author uses literature data on the radio brightness of the Venusian disk at waves of 0.8, 3.15, and 9.6 cm for different phases of the planet. It is assumed that the Venusian radio emission in the cm range is composed of proper thermal radiation of the planetary surface and thermal radiation of its ionosphere. A formula is obtained for the brightness temperature T_v. To explain the values of T_v obtained from the experiment, the author took the following ionospheric parameters: mean kinetic temperature $T_2 = 10^3$K, the electron concentration in the subsolar point $N_{e\ max} = 10^9\ cm^{-3}$, thickness of the ionospheric layer $l = 3 \times 10^7$ cm. In addition, it was assumed that the mean temperature of the Venusian disk $T_1 = 300$K, and the mean coefficient of reflection of the planetary surface $R = 0.2$. The author concludes that if the model he has accepted is correct, then the brightness temperature of Venus should be a constant for wavelengths $\lambda > 10$ cm (i. e., does not depend on λ), while the radio emission should (in the presence of a magnetic field) be elliptically polarized.

121. Vetukhovskaya, Yu. N., A. D. Kuz'min, B. G. Kutuza, B. Ya. Losovskiy, and A. Ye. Salomonovich. Measurements of the radio emission spectrum of the night side of Venus in the centimeter wavelength range. Izvestiya vyshikh uchebnikh zavedenii. Radiofizika, v. 6, no. 5, 1963, 1054-1056.

The investigation covers the range of wavelengths from 8 mm to 3 cm, which is the transition region between two previously investigated ranges (4—8 mm and 3—40 cm), for which brightness temperatures of about 350 and 600°K, respectively, were obtained earlier by various investigators. The measurements were made with modulation radiometers at wavelength 0.8, 1.6, and 3.3 cm using a procedure described previously (Astronomicheskiy zhurnal, v. 39, 410 and 660, 1962). The apparatus calibration procedure is described. The results are compared with the published data.

IV. Tektites

122. Kadushin, A. A., and G. G. Vorob'yev. Method of investigating meteorites and tektites through the use of infrared spectrometry. Meteoritika, v. 22, 1962, 104-109. QB775.A4

The Zeiss Works in Jena has developed a new infrared spectrometer for the study of meteorites and tektites. The spectrometer, the UR-10, is designed for work in the 2--25 μ range by automatically changing three prisms: KBr, NaCl, and FiF. Tests have already been conducted with 1) suspension, 2) powder, and 3) tablet samples.

123. Starik, I. Ye., E. V. Sobotovich, M. M. Shats, and S. M. Grashchenko. On the question of the origin of tektites. Meteoritika, v. 22, 1962, 97-103. QB775.A4

On the basis of geochemical analysis, the content of uranium and lead and the isotopic composition of the lead in various tektites has been determined.

124. Starik, I. Ye., G. G. Vorob'yev, E. V. Sobotovich, M. M. Shats, and S. M. Grashchenko. Origin and age of tektites. IN: Akademiya nauk SSSR. Komissiya po opredeleniyu absolyutnogo vozrasta geologicheskikh formatsiy. Byulleten', no. 5, 1962, 26-34. QE1.A3458

Chemical analysis suggests that tektites were formed under extreme high-temperature conditions and long-duration heating. Primary cooling of the fusion occurred under flight conditions, resulting in the monopolar shape of tektites with characteristic spiral torsion structure. Later, they were subjected to a secondary surficial heating, resulting in the formation of pure silicon dioxide—lechatelierites. On the basis of potassium-argon determinations tektites are divided into three age groups: North American, about 30 million years; moldavites, about 10 million years; and Indoaustralian, less than 1 million years. The secondary refusing occurred relatively recently. Mathematical processing of data on the concentration of uranium and lead and the isotopic composition of the lead indicates that tektites separated from their parent material in recent gedogic times.

Processing of data further indicates that tektites could not have been formed from igneous or terrigenous sedimentary rocks. They could only have been formed from meteoric bodies if they had undergone a partial loss of lead during their flight to the Earth. The absence of radiogenic isotopes of lead is indicative of the possibility that tektites developed from several natural formations.

125. Vorob'yev, G. G. Experience in the use of punched cards in studying tektites. Meteoritika, v. 22, 1962, 157-161. QB775. A4

A punched card system has recently been developed as an aid in tektite investigations. A standard card of German manufacture (DIN A5 [Order no. 50/011]) 207 x 147 mm in size, framed by a double row of 215 holes, is employed. Some 2000 different characteristics may be encoded. This punched card system is considered an example of the successful application of cybernetics in information theory.

AUTHOR INDEX

Matveyev, I. V. Astronaut orientation on the Moon. Vsesoyuznoye astronomo-goedezicheskoye obshchestvo. Byulleten' no. 33(40), 1963, 37-40; Shevchenko, V. V. Izvestiya vysshikh uchebnykh zavedeniy. Geodeziya i aerofotos"yemka, no. 1, 1963, 87-91.

A star chart of the northern lunar hemisphere, containing 62 stars, has been compiled in stereographic projection with ecliptic coordinates computed for the epoch 1960.0. The chart covers the circumpolar zone of the northern lunar hemisphere within the limits of 50° and is intended to facilitate orientation on the Moon. The north lunar pole will be in the constellation of Draco, while the south lunar pole will lie in the constellation of Dorado. A method has been devised to enable an astronaut on the Moon to determine his exact position by measuring the zenith distance of the center of the Earth. Corrections must be introduced for libration. The method is based on the fact that for an observer located in the center of the visible hemisphere of the Moon, the Earth will appear near the zenith with slight departures owing to libration. The closer the observer is to the limb of the Moon that is visible from the Earth, the lower the Earth will be over the lunar horizon.

Structural elements of the Moon resemble those of Earth and Mars. Kosmicheskiye issledovaniya, v. 1, no. 3, 1963, 465-471.

Selenological investigations conducted by Yu. A. Khodak suggest the existence of a lunar block structure, evolutionary development from major structural elements, and differential movement of major elements along deep fault zones from an ancient to a recent period. The lunar block structure, resembling that of Earth and Mars, attests to similar patterns of development of the hard crusts of these bodies.

Rybchinskiy, Yu. Radiosurvey of the Moon. Kazakhstanskaya pravda, 5 Oct 1963, 4.

While describing the Oksk Station, whose radio telescope is considered one of the world's best, the author says that the primary problem of radioastronomers today is the study of

neighboring planets and the Moon. Most interesting information was obtained during a sounding of the Moon. A group of scientists from the Radiophysical Institute, Gorkiy University, studied the lunar radio emanations in the 0.13—35 cm wave range, which corresponds to a "scanning" of its surface layer to a depth of 5—20 m. The measuring error did not exceed 1—2%. The results obtained substantially changed our previous conception of the Moon. The Moon is believed to have a hot core. The rocks on the Moon's surface resemble our granites and diorites, but their physical properties are quite different. The lunar surface is not a thin dust, as first assumed, but a porous substance, similar to pumice, which will float in water. A house built from lunar rocks would be distinguished by high heat-insulation properties since they possess a heat conductivity 30—40 times smaller than ours.

Petrova, N. Lunar luminescence. Sovetskaya molodezh, 16 Oct 1963, 3.

The Soviet astronomer Nikolay Kozyrev (Pulkovo Observatory) detected violet luminescence of the lunar surface in the area of the Aristarchus Crater and Mare Crisium. His observations were confirmed by the French astronomer Dubois. Kozyrev ascribed the phenomenon tothe presence of quartz. The Soviet astronomer Vsevolod Troitskiy also came to the conclusion that most of the lunar rock formations consist of quartz. He also suggested that luminescence may be due to aluminum oxides activated by such impurities as chromium. Kozyrev considers gases evolving from lunar craters as another possible source of luminescence due to the corpuscular and uv solar radiation.

Lunar surface. Leninskaya smena, 19 Oct 1963, 4.

N. Barabshov reports that automatic electric indicatorometric studies of light reflection from experimental Earth materials indicate that the lunar surface most resembles a fragmented volcano tuff with irregularities ranging from one to several millimeters. Both color and the degree of polarization correspond. Theoretical computations also suggest that the lunar surface is a spongy volcanic rock whose porosity exceeds that of the most porous terrestrial rocks. Radio-astronomical investi-

gations by V. Troitskiy and A. Salomonovich indicate that the irregularities of the lunar microrelief are less than 1 cm.

Lunar motion. Leninskaya smena, 24 Oct 1963, 4.

Soviet scientist Vladimir Kondurar has shown in a recent work that the oblateness of the Moon exerts a significant influence on the motion of that body around the Earth. Kondurar has shown that the center of the lunar sphere during revolution around the Earth can deviate 1.5 km from the "unperturbed" orbit either in the direction of the Earth or away from it. The lunar nonsphericity, Kondurar asserts, will also affect the rotation of the Moon about its own center. The perturbation is most noticeable in the precession of the orbital line of nodes and may amount to half an angular minute per year. This irregularity must be taken into account in computing the position of the Moon and in time computations.

Laser contact with the Moon. Izvestiya, 6 Nov 1963, 3.

In a recent interview, A. B. Severnyy, Director of the Crimean Astrophysical Observatory, provided additional information on the equipment used in the successful laser contact with the Moon. The laser which sent the light impulses to the Moon was mounted in the focus of the 2.6-m telescope of the Crimean Observatory. A special device with very sensitive photomultipliers, also set at the focus of the telescope, received the impulse reflected from a small zone of the "young" Moon on which the rays from the Sun do not fall. The intensity of the impulse received was 10^9 times weaker than that of the impulse sent. Severnyy believes it will now be possible to determine the figure of the Moon and the distance to different parts of the lunar surface with an accuracy at least 100 times greater than that achieved by any method now used. Light signals will also make it possible to compile an accurate map of lunar motion around the common center of mass of the Earth-Moon system.

Volcanic activity on the Moon. Izvestiya, 14 Nov 1963, 4.

Soviet astronomer N. Kozyrev, commenting on a recent observation by Lowell Observatory scientists of eruptions on the Moon, expressed the opinion that lunar craters are of volcanic origin and that the lunar surface is therefore hard and porous, being covered by solidified lava streams. This is in contrast to the meteorite theory, by which it is thought that the lunar surface is covered with a considerable layer of dust, which would be a great hazard in attempting direct landings of spaceships. According to Kozyrev, confirmation of his theory would obviously be of great importance with regard to lunar landings. Kozyrev twice (four and five years ago) observed eruptions from the same lunar crater.

Surface structure of the Moon. Izvestiya, 15 Nov 1963, 6.

According to V. S. Troitskiy, director of a lunar research group in Gorkiy, the data obtained from radio sounding suggests that the surface of the Moon is porous and solid. The top layer, up to 10—12 cm in depth, is porous; the underlying 20—30-m layer is denser and almost homogeneous and overlays rocklike formations. The thermal conductivity of the top surface layer of the Moon is 50—100 times less than that of the Earth. Studies of the emissions of separate sections of the Moon up to 200 km in diameter confirmed that both the structure and nature of the surface is identical in all areas.

Laser-drawn lunar maps expected. Dziennik zachodni, 17-18 Nov 1963, 6.

M. Keldysh, President of the Academy of Sciences USSR, said that Soviet scientists will use lasers to draw lunar relief maps with a 30-cm accuracy. Reflections of a laser-beam source, located in the focus of a telescope mirror 2.6 m in diameter, have been obtained at the Crimean Astrophysical Observatory.

Safronov, V. S., and Ye. L. Ruskol. Possible presence of ice on the Moon. Voprosy kosmogonii, v. 9. 1963, 203-214.

On the basis of cosmogonic considerations, the authors believe that the most abundant components in the lunar atmosphere,

water and carbon dioxide, have been dissociated into atomic oxygen and carbon monoxide. Liquid water probably never existed on the lunar surface, since the density of the water vapor was always much lower than the saturation density. It is held unlikely that methane ever existed in the lunar atmosphere, since in the presence of free oxygen it is unstable. The authors reject the contention of Watson, Murray, and Brown that water could be retained in lunar "cold traps." However, the Soviet investigators note that an underlying permafrost zone could exist, if it were protected from meteorite impacts and evaporation by overlying rock. These zones, the authors believe, would most likely be found in the regions of the "continents," where there were no lava flows. The authors reject Sagan's view that some complex organic compounds may be found in the lunar soil on the grounds that the thinness of the lunar atmosphere, the absence of the necessary gases, and the predominance of photodissociation processes over those of synthesis would have been unfavorable for their formation.

Markov, M. N., et al. Soviet infrared studies of lunar surface. Krymskaya astrofizicheskaya observatoriya. Izvestiya, v. 30, 1963, 284-296.

The thermal radiation of two areas of the lunar surface (center and limb) has been measured in the 8—14-μ range. Observations were made with a radiometer attached to the 122-cm reflector of the Crimean Astrophysical Observatory; a bolometer was used as the radiation receiver. The thermal flux and the albedo of details on the lunar surface were found to be in complete agreement. The thermal radiation of bright details (mountains, continents, bright rays, etc.) is less that that of dark seas and the floors of dark craters. The thermal fluxes from Aristarchus Crater and the surrounding seas differ by about 10%. Computations show that this difference cannot be explained by the differences in albedoes alone. The flow inwards, due to thermal conductivity, apparently plays a greater role in the case of Aristarchus than for the surrounding regions.

Detection of the hot interior of the Moon. Astronomicheskiy zhurnal, v. 40, no. 6, 1963, 1076-1082.

An increase in the temperature beneath the lunar surface to a

depth of 20 m has been detected. The temperature gradient is 1.6° /m, indicating that the material throughout the layer is homogeneous, very porous, and not comprised of dust. The density of the thermal flux from the Moon's interior is found to be 1.3×10^{-6} cal/cm^2/sec, corresponding to that of the Earth. It is believed that the heat observed is due to the radioactive decay of elements and that thermal flux characterizes the concentration of radioactive elements in lunar material.

Kozyrev comments on new lunar outgassings. Sovetskaya kirgiziya, 25 Dec 1963, 4.

Commenting on the recent detection by American investigators (Greenacre, et al.) of a reddish area in the vicinity of Aristarchus, Kozyrev states, "The phenomenon of sharp coloring could only have been caused by an outgassing, the brightness of which was particularly clear against the background of the lunar surface in the area of sunrise...no doubt the result of a deep-lying process." On the matter of lunar and terrestrial volcanism, Kozyrev notes, "You know, more and more I'm coming to the conclusion that possibly there is a profound difference in the chemical composition of the outer layers of the Moon and the Earth. This would be extraordinarily important. It could throw a new light on the problem of the origin of our planet and the Moon."

Television apparatus tested for Moon probes. Funkamateur, no. 12, 1963, 411.

Television equipment intended for future investigation of the surface of the Moon has been tested for durability in the USSR. The apparatus was dropped without parachute from 2000 m and remained in operating condition.

Radio investigations of Moon reveal structure to depth of 40 m. Pravda, 24 Jan 1964, 4.

On the basis of measurements of lunar radio emission at 70 cm, V. Troitskiy, V. Krotikov, and N. Tseytlin have inferred that solid rock formations underlie the porous surface layer of the Moon at a depth of about 30 m. If the density of

lunar matter remained constant to a depth of 40 m, the investigators state, a temperature increase of 20—30°C might be expected at that depth as compared with the temperature at a depth of 20 m. Instead, the increase was found to be much less and is interpreted as indicating the presence of solid formations.

Surface of the Moon. Soviet news (London), 6 Feb 1964, 59.

Professor A. Markov of the Pulkovo Observatory rejects the theory that the Moon's surface is covered with a layer of dust up to 100 ft deep on the grounds that at least 70% of the elements on the lunar surface lie at very sharp angles to the horizontal, making it physically impossible for dust of that thickness to remain at rest. Markov is of the opinion that dust and highly porous "soil" cover the Moon's surface to a depth of approximately 12—20 in. The latest Soviet radar experiments using the 70-cm wavelength indicate that at a depth of about 100 ft, there is a dense layer which may possibly be bedrock.

Craterlets in the vicinity of Copernicus. Astronomicheskiy zhurnal, v. 51, no. 2, 1964, 418-419.

It has been found that the linear diameters of 4336 craterlets and domes in the vicinity of Copernicus show a logarithmic normal distribution. This is considered statistical evidence that they were formed simultaneously.

Radio emission of the Moon being studied. FBIS: Daily Report, USSR and East Europe, no. 50, 12 Mar 1964. (from Moscow)

Soviet scientists have established that the intensity of the Moon's radio emission differs periodically. Data on radio emission suggests that the 20- to 30-m layer of loose porous substance on the surface of the Moon apparently lies on hard rock. "There is no doubt that the Moon's interior is solid," says V. Troitskiy, Doctor of Physics and Mathematics. This is evidenced by the shape of the Moon, which is elongated strongly in the direction of the Earth. This shape could not be maintained by the forces of internal gravitation and the Earth's gravitation if the Moon had a liquid interior.

Composition of lunar surface studied by Soviets. Scinteia (Rumania), 8 Apr 1964, 3.

Soviet astrophysicists of Gorky University, under the leadership of Vsevolod Troitskiy, after studying the intensity of radio waves over the entire lunar disk, have concluded that the lunar surface is almost homogeneous. The lunar "seas" consist of basalt-type rocks, whereas the "continents" are made up of acid rocks of the granite type. It appears most likely that the substance of the lunar crust contains 60% quartz, 15—20% aluminum oxide, and 20—25% potassium, sodium, calcium, iron, and magnesium oxides. Unlike the terrestrial rocks, all lunar rocks are extremely porous.

Water on Moon held possible by Soviet scientist. Rude pravo (Czechoslovakia), 26 Apr 1964, 2.

According to the cosmogonic theory of the Soviet scientist O. I. Shmidt, the Moon was created by successive accumulations of solid cosmic particles at temperatures of only several hundred degrees (K) above absolute zero. If so, then during the initial period of formation some 11,300,000 billion tons of water should have been uniformly distributed throughout the mass of the Moon. Later, however, the heating-up of the interior of the Moon (due to nuclear processes) took place, causing "drying" of its core. The released water rose to the surface. Such considerations lead many scientists to the conclusion that the Moon's crust must contain water in the form of glaciers under the surface. It is also possible that the progressive motion of the water toward the lunar surface played a certain role in the formation of the surface.

von Bulow, Kurd. Origin of lunar domes discussed. Geologie (E. Germany), no. 4, 1964, 449-455.

Lunar domes are found exclusively in the region of terrae that are covered by a relatively thin lava sheet (so-called epicontinental maria). Their shape, material, and position suggest an inflation process rather than a magma uplift. Small unwalled peak craters without detectable eruptive masses also indicate the action of a highly compressed gas. These findings pertain solely to small and medium-sized

lunar domes, and not to lava plateaus, large volcanoes, craters, walled plains, and the like. Thus, they are in no way related to the older bubble or steam-push theories.

Radioactive elements on the Moon. Horyzonty techniki (Poland), May 1964.

According to Soviet radio astronomers, the concentration of radioactive elements on the Moon is from 5 to 6 times higher than that on the Earth.

Soviet Moon exploration. Kridla vlasti (Czechoslovakia), no. 5, 1964.

Soviet astronomers, using electron previously polarimetric photography, recently discovered ten unknown circular mountain formations and craters on the Moon. These formations could not be previously observed by optical methods because lava streams melted the steep walls of the craters in such a way that the remaining contours were hardly distinguishable.

Mikhaylov, A. (Director, Pulkovo Observatory). Origin of the Earth-Moon system. Nedelya (Sunday Supplement, Izvestiya), no. 21, 17-23 May 1964, 5.

The author finds the views of Swedish astrophysicist H. Alfven (a guest lecturer at the Pulkovo Observatory) on the origin of the Earth-Moon system most plausible and promising. Alfven's theory, a further development of ideas advanced by the German theoretician Gerstenkorn in 1955, contends that the Moon was originally an independent planet which approached the Earth along a parabolic orbit. At the time of capture by the Earth, the inclination of the lunar orbit to the Earth was 150°. When the orbital inclination reached 90°, huge masses were torn from the Moon and fell to Earth, forming the continents. If this was indeed the case, the density of the Moon would be equal to that of the terrestrial crust, not because the former was torn away from the latter as had been thought earlier, but, rather, because the Earth's crust represents lunar matter drawn to Earth some 2.5 billion years ago.

Soviets gather more information on the nature of the lunar surface. Pravda vostoka, 29 May 1964, 4.

Professor A. V. Markov, head of a group of planetary physicists at the Pulkovo Observatory, says that "the depth of very porous soil on the Moon cannot exceed 30—40 c." Data obtained at Pulkovo, Gorky, and Cornell University indicate that the specific gravity of the lunar crust at a depth of one meter reaches the order of one, while in the uppermost part of the crust it does not exceed 0.5. "In all probability," says Markov, "the lunar surface is spongy." The "dust theory" has been disproved on the basis of a determination which was made of the key physical characteristics of the moon in Khar'kov, Leningrad, and Pulkovo. The temperature of different zones of the lunar surface in the course of the lunar day was studied with a new-type Maksutov reflector and the bolometer at Pulkovo. Using interference filters on the MTM-500 meniscus telescope, Nina Orlova has obtained about 80 negatives, on the basis of which she has established the distribution of chemical compounds on the lunar surface. The investigation was made possible by the luminescence of several of the compounds under the influence of prolonged solar radiation. Nina Petrova has established for the first time the special features of light reflection from several sectors of the lunar surface in red and ultraviolet light. This also argues against the dust theory.

Moon chart in 25 sections (book note). Sky and Telescope, no. 5, 1964, 305.

Facsimile reproductions of the famous lunar atlas "Mondkarte in 25 Sektionen," by W. G. Lohrmann, have been published and are available through Johann Ambrosius Barth, Leipzig. In the portfolio containing the 25 charts is a 30-page explanatory booklet by the present editor, Paul Ahnert, which includes the 1878 text by J. G. J. Schmidt. The German language is used throughout.

Soviets photograph Moon in earthshine. Izvestiya, 3 Jun 1964, 4; Pravda, 3 Jun 1964, 4.

At an altitude of 3860 m above sea level in the eastern Pamirs, Pulkovo astronomer Sh. P. Darchiya succeeded in photograph-

ing details of the Moon in earthlight. Photographs were made with the AZT-7 mirror telescope and a Zenit-S camera. Exposure of 3 min, 1 min, and 20 sec were made. (Izvestiya) A. A. Mikhaylov, Director of the Pulkovo Observatory, commented on the event: "Astronomers have often noted a glowing of individual details on the lunar surface on the unilluminated side of the lunar disk, that is, under earthshine conditions. However, this phenomenon has not been confirmed by documenting instrumental observations. Now there are grounds to believe that the probable cause of the phenomenon might be the luminescence of rocks under the action of cosmic rays or solar corpuscular radiation." (Pravda)

Analysis of photos of the Moon taken in earthshine. Sovetskaya latviya, 3 Jun 1964, 4.

N. S. Orlova and Sh. P. Darchiya will discuss the unique photo of lunar details taken in earthshine in the next issue of the Transactions (Izvestiya) of the Main Astronomical Observatory in Pulkovo. Comparing the relative distribution of brightness of the lunar disk in the earthshine and at full Moon, these astronomers have found that in some sectors of the lunar surface near the eastern and northeastern limb the brightness is greater in the earthshine. These regions are located near the Sinus Roris and Grimaldi crater. Orlova and Darchiya believe that the phenomenon may have been caused by the luminescence of rocks under the action of cosmic rays of solar corpuscular radiation.

Soviet astronomers detect luminescence on night side of Moon. Berliner zeitung (E. Berlin), 21 Jan 1964, 4.

Soviet astronomers taking scientific photos in the Pamirs at an elevation of 3800 m, have observed repeated luminescence on the night side of the Moon. Even comparison with brightness of the lunar disk in earthshine and full Moon confirms that a greater brightness occurs in places on the eastern and northeastern lunar limbs. Scientists at the Pulkovo Observatory explain the phenomenon of luminescence of lunar rocks as the result of cosmic radiation or solar corpuscular streams.

Soviet astronomer believes there are hydrocarbons on the Moon. Wiedza i zycie (Poland), no. 6, 1964, 273.

Soviet astronomer Dr. Nikolay Kozyrev announces new proofs to support his assertion that molecular hydrogen issues from the lunar crater Aristarchus. He also believes that hydrocarbons exist on the Moon. (In 1958, Kozyrev discovered carbon particles in another lunar crater, Alphonsus.)

Technical details of ruby laser used to contact Moon described. Akademiya nauk SSSR. Doklady, v. 154, no. 6, 1964, 1303-1305.

A ruby laser, designed by V. S. Zuyev and P. M. Kryukov, was used in conjunction with a 2.6-m mirror telescope on 13 September 1963 to illuminate a sector of Albategnius Crater. The laser has the following parameters: wavelength 6943 A, pulse energy 50—70 j, pulse duration 2 msec, beam diameter 11 mm, beam divergence 3'. A photoelectric multiplier was used to record the reflected signal. In all, 30 pulses were sent, amounting to an accumulated signal time of 60 msec. A diagram of the apparatus used is given.

Soviet studies indicate lunar seas and continents have some chemical composition. Komsomol'skaya pravda, 9 Jul 1964, 2.

New investigations of the upper cover of the Moon, conducted by Gorky radiophysicists under the direction of V. Troitskiy, indicate that the materials composing lunar "seas" and "continents" are the same or very similar in chemical composition. Previously it had been thought that the "seas" were made mostly of basalt, while the "continents" consisted of granitic rock. Preliminary radio investigations now suggest that lunar matter corresponds for the most part to volcanic tuffs and granites. The upper layers of the lunar surface is very porous to a depth of at least several meters.

New Soviet lunar astronomical calendar compiled for astronauts. Sovetskaya latviya, 24 Jul 1964, 1.

Senior Ukrainian astronomer A. Yakovkin, author of original works on lunar research, has compiled a "lunar astronomical

calendar." The calendar consists of three sections: a star catalogue suitable for observations from the surface of the Moon, various auxiliary tables, and a diagram of an original automatic theodolite. The latter is necessary because the usual instrument for measuring angles would be useless on the Moon, where the temperature sinks to minus 150°C, where the daily revolution of the lunar celestial sphere is slowed, and where there is no atmosphere. The scientist freely used the most recent advances in automatic devices and telemechanics in designing the theodolite. Yakovkin believes that by using his computations the future astronaut will easily be able to determine his location at any point on the lunar surface, so as to be able to report his new "address" to the Earth. The "lunar astronomical calendar" was published by the Ukrainian Academy of Sciences Publishing House.

Appendix B. Mars

Higher types of plant life on Mars? Soviet news, 30 Aug 1963, 2.

Astrobiologists in Kazakhstan have established that the spectra of light reflected by vegetation on the Earth which is highest (and youngest) in the evolutionary scale, somewhat resemble the spectra obtained by astronomers from the blue-green areas on Mars. In the opinion of scientists this supports the hypothesis that higher types of vegetation may exist on Mars. Extensive investigations of the spectra of Earth vegetation carried out in Kazakhstan have shown that the older the type of vegetation from the evolutionary point of view, the less it absorbs red rays.

More information about Mars. Soviet news, 11 Sept 1963, 139.

The processing of the information obtained last spring during the period of the opposition of the planet Mars has now been completed. The new data show that the concentration of carbon dioxide on Mars is only 20% of what it had been believed to be. Spectroscopic research suggests that the surface of the planet's bright areas consists of a type of brown hematite. Recordings of the spectrum of Mar's polar caps in the infrared confirm that they consist of frozen water, that is snow, frost, or iced clouds.

Spectra of light from Mars. Kridla vlasti, 16 Sep 1963.

Kazakh astrobiologists found that the spectra of light reflected from higher plants on the Earth resemble to a certain extent spectra which were obtained by astronomers from the blue-green spots on Mars. The scientists feel that this fact provides evidence in support of the hypothesis that higher plants exist on Mars.

Photos of Mars. Zarya vostoka, 11 Oct 1963, 4.

Computers have been employed in the reduction of about 50 photos of Mars obtained at the Pulkovo Observatory during

the last opposition in 1960-1961. The information obtained will make it possible to increase the accuracy of determination of the orbital elements of the planet. A. N. Deych reports that the use of a special filter on the short-focus dual astrograph resulted in cutting down the planet's brightness which in the past had so often handicapped photography.

New data about Mars. Stiinta si tehnica, no. 11, 1963, 33.

Soviet astronomers have completed their interpretation of observations of the planet Mars conducted during the opposition of this year. It was found that the concentration of carbon dioxide on Mars is five times less than it was believed to be. Spectrograms justified the assumption that the bright regions on the surface of Mars are rich in iron hydroxide, a limonite-type rock. Infrared spectra of the polar caps confirmed the opinion expressed earlier as to the existence of snow, hoarfrost, and crystal clouds in these areas.

Radar investigations of Mars reveal surface topography. Radio und fernsehen (E. Germnay), no. 1, 1964, 2.

A very detailed radar investigation of Mars was carried out by Soviet scientists when that planet was located 100,000,000 km from the Earth. The reflected bandwidth of only 4 cps (in theory another bandwidth of 2200 cps was possible) indicated that long flat areas, several kilometers in length, occur on the Martian surface. In addition, places also exist where the day temperature exceeds 0°C.

Helicopter for use in Martian atmosphere. Narodna armija (Belgrade), 31 Jan 1964, 8.

Soviet inventor A. Bankovskiy has been awarded a patent for a jet-propelled helicopter for use in the Martian atmosphere. An artist's drawing of the helicopter is included.

Moroz, V. I. Infrared spectrum of Mars. Astronomicheskiy zhurnal, v. 51, no. 2, 1964, 350-361.

Observations of the IR spectrum of Mars have been made with the 125-cm reflector and two spectrophotometers of the Southern Station of the Shternberg Astronomical Institute. In the 1.1—2.5 μ region 12 new planetary CO absorption bands were detected. The pressure at the planet's surface is believed to be less than 100 mb. The presence of ice absorption bands in the polar cap spectrum has been confirmed. Four unidentified absorption bands, 3.43, 3.53, 3.59, and 3.69 μ, have been identified with Sinton's "life bands."

Exact positions of Mars and Venus studied at Pulkovo Observatory. Kazakhstanskaya pravda, 12 Apr 1964, 3.

Photographic observations of Venus and Mars are being made at the Pulkovo Observatory for the purpose of determining their exact position in space. Aleksandr Deych, Head of the Department of Photographic Astronomy, notes that a knowledge of the precise positions of these bodies is important in planning future rocket flights. He says, "Of course many years will pass before people fly space routes to other worlds of the solar system. But it is necessary to prepare for them now." A new type of plate holder was employed in the photographic observations of Venus, making it possible to increase the accuracy of determining its position. For the first time, a double short-focus camera was used in photographic observations of Mars, increasing the accuracy in the determination of its position.

Martian oceans hypothesized by Soviet scientist. Berliner Zeitung (E. Germany), 19 Apr 1964, 4.

The planet Mars, according to a hypothesis of Professor V. Kessarev, has an ocean one-third the size of the one on the Earth. This hypothesis is based on five years of observation. Kessarev reports that in the water balance on Mars, as on the Earth, moisture use is less than moisture influx.

Helicopter for use on Mars proposed. Stiinta si tehnica (Rumania), Apr 1964, 34.

A dissertation submitted by student A. Bankovskiy in Moscow features a helicopter with jet-powered rotor blades. The helicopter is equipped with a compressor-turbine unit to discharge air into the jet blades. Taking into account the rarefaction of the Martian atmosphere, liquid oxygen is carried by the helicopter. There are no tail rudders, the directional control being provided by controllable gas jets formed with gases escaping from the turbine.

Appendix C. Venus

Klyakotko, Mikhail. Latest data on the Venusian atmosphere. Turkmenskaya iskra, 18 Sep 1963, 4.

Analysis of spectra obtained in the vicinity of the Venusian equatorial and polar regions at the Crimean Astrophysical Observatory indicates the presence of unstable dark spots in the atmosphere that may be attributable to different absorption of solar radiation in the violet region of the spectrum. On the basis of Doppler effect studies, Vladimir Prokof'yev has confirmed the existence of oxygen in the Venusian atmosphere. Vasiliy Moroz had detected three bands of carbon dioxide and its isotope; three other bands could not be identified with known elements. Moroz further asserts that the Venusian cloud layer is composed of dust rather than ice particles. Recent investigations indicate that no magnetic field and hence no radiation belts surround the planet. Radio investigations of Arkadiy Kuz'min and Aleksandr Salomonovich at the 8-mm and 3.3-cm wavelengths show that the mean temperature of the planet changes in a 72-day period, suggesting a synodic period of 72 days. It is surmised that continents and oceans occupy the planetary surface. Venus is believed to have a direct rotation like the other planets. It rotates on its own axis in about 69 earth days; average solar days on Venus are equivalent to about 98 earth days.

Oxygen detected in Venusian atmosphere. Izvestiya krymskoy astrofizicheskoy observatorii, v. 29, 1963, 3-14.

V. K. Prokof'yev and N. N. Petrova have obtained spectra of reflected light from Venus in the region of the telluric oxygen α-band at a dispersion of 1 Å/mm with the Pulkovo solar tower telescope spectrograph. Photometric reduction of the plates showed an asymmetry in the lines of the telluric oxygen α-band. This asymmetry may be due to a faint oxygen absorption band formed in the region above the cloud layer of the Venusian atmosphere.

Clouds on Venus. Stiinta si tehnica, no. 11, 1963, 33.

The Soviet astronomer, V. Prokof'yev, of the Crimean Astrophysical Observatory, has found that the atmosphere surrounding Venus contains oxygen. Another astronomer, V. Moroz, has discovered six new details in the atmospheric spectrum of this planet, three of which are similar to carbon dioxide and to one of its isotopes; the other three lines have not yet been identified. Moroz reached the conclusion that the clouds of the "Planet of Storms" are not made up of ice crystals, but rather of some dust particles with chemical composition still unknown. Last year this astronomer reported that the clouds in the atmosphere of Venus contain a substance which strongly absorbs infrared rays. The origin of this substance could not be determined.

Venus research. Komunist, 17 Nov 1963, 4.

Spectra recently obtained at the Crimean Astrophysical Observatory on the equatorial and polar regions of Venus indicate the existence of nonstable dark formations in the atmosphere of that planet. Changes in the position and size of the spots are attributed to the different absorption of solar radiation in the violet sector of the spectrum. V. Prokof'yev has, on the basis of Doppler effect studies, detected six new details in the spectrum of the atmosphere of Venus. Three bands were identified with carbon dioxide and its isotope; three could not be identified. The ratio of carbon dioxide to its isotope is found to be the same in the Venusian as in the Earth's atmosphere, i.e., 100—200 to 1. Moroz further determined that the Venusian cloud layer consists of dust rather than ice particles. He believes that a gas, opaque to thermal solar radiation, will be found to explain the greenhouse effect on Venus. Recent investigations indicate the absence of a magnetic field and hence of radiation belts around Venus. A. Kuz'min and A. Salomonovich, conducting radioastronomical investigations at wavelengths of 8 mm and 3.5 cm, established the rotation period of Venus at 69 earth days and the mean solar day on Venus at 98 earth days.

Venusian atmosphere. Berliner zeitung, 23 Nov 1963, 5.

During spectrographic studies made at a height of 3000 m above sea level in the southern part of the USSR, astronomer I. Glushneva found no complicated polyatomic organic molecules in the Venusian atmosphere. She concludes that life could not possible exist on the planet. Her view is supported by the Director of the State Astronomical Institute, Professor D. Martynov.

Danilov, A. D. Venusian atmosphere. Kosmicheskiye issledovaniya, v. 2, no. 1, 1964, 121-135.

Two hypotheses now exist concerning the Venusian atmosphere, the greenhouse theory and the ionospheric theory. According to the former, Venus has a good deal of water (not yet detected) or a very high surface pressure of several tens of atmospheres. One difficulty of the ionospheric theory is that it requires the existence of high electron concentrations of the order of 10^9 cm^{-3} in the Venusian ionosphere. Radar and spectral studies suggest a porous Venusian ionosphere. In this event there is no difficulty in explaining the absence of limb brightening observed experimentally at 1.6 and 3 cm. Correlation of the value of the astronomical unit with solar activity indicates the presence of a thick Venusian ionosphere.

Soviets determine rotation period of Venus. Radio und fernsehen (E. Berlin), no. 7, Apr 1964, 194.

According to radar determinations made by Soviet scientists, the period of rotation of Venus about its axis is 10 $\pm$ 1 terrestrial days.

Soviet scientist claims confirmation of existence of oxygen in Venusian atmosphere. Leningradskaya pravda, 17 May 1964, 4.

The original detection of molecular oxygen in the Venusian atmosphere by V. Prokof'yev and N. Petrova in 1961 was made when Venus was receding from the Earth and the spectral lines were shifted towards the red. Analysis of more recent spectrograms, made when Venus was approaching the

Earth and the spectral lines were shifted towards the violet, have again confirmed the presence of oxygen. The amount of oxygen, Prokof'yev states, is rather insignificant and pertains only to the upper layer of the Venusian atmosphere.

New Soviet data on radius of Venus. National zeitung (E. Germany), 20 May 1964, 6.

Soviet scientist Kotel'nikov reported at a scientific conference in Moscow that radar investigations have shown that the Venusian radius is 80 km greater than had been hitherto believed.

Soviet Professor Prokof'yev reports completion of first stage of Venus observations. Komsomol'skaya pravda, 21 Jun 1964, 2.

On 19 June Venus reached inferior conjunction some 50,000,000 km from the Earth. Commenting on Venus research at the Crimean Astrophysical Observatory, Prof. V. K. Prokof'yev reports: "We have finished the first stage of Venus observations. We succeeded in obtaining a large number of good spectra of the planet. They are being processed now. Earlier we determined the presence of oxygen in the Venusian atmosphere. Now on the basis of the new spectra, we are trying to determine the quantitative content of oxygen in the atmosphere of our neighbor planet."

New series of radar investigations of Venus underway in USSR. Pravda, 5 Jul 1964, 6; Trud, 5 Jul 1964, 1.

A new series of radar investigations of Venus, employing new instrumentation developed in the Institute of Radio Engineering and Electronics under the direction of V. A. Kotel'nikov, is now under way. The magnetic tapes on which the radar echoes are recorded are processed by electronic computers. The useful signal is automatically separated from the general background of cosmic radio emission. The distance to the planet can now be determined accurately to within several kilometers. Radar studies have already revealed that the surface of Venus is solid, resembling quartz, and is less irregular than either Earth or Mars. Venus rotates on

its axis 200—300 times more slowly than does the earth. One thousand radar probes of Venus have already been made, and it is hoped that new data will be forthcoming on both the orbital elements and the surface features of the planet.